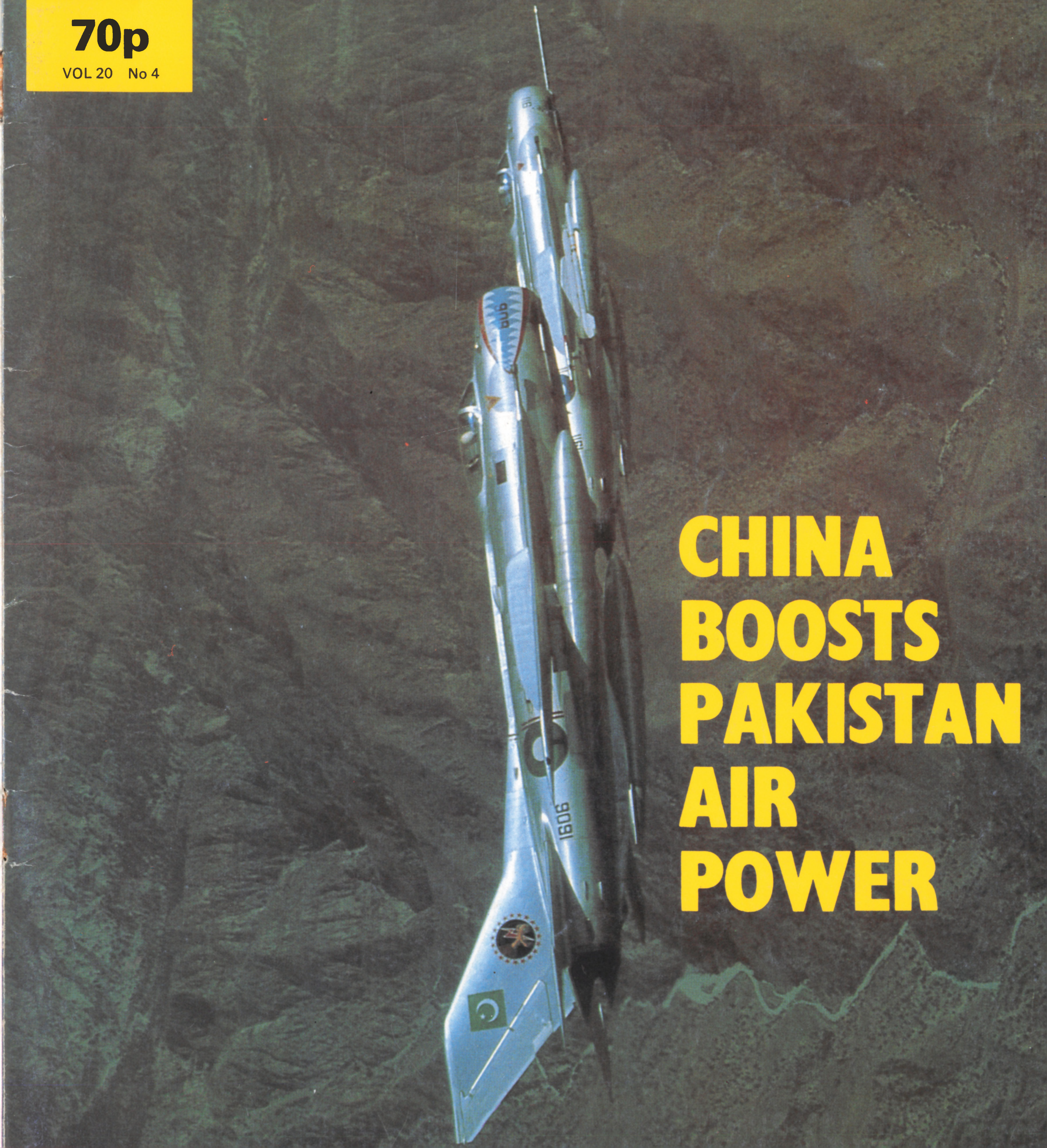
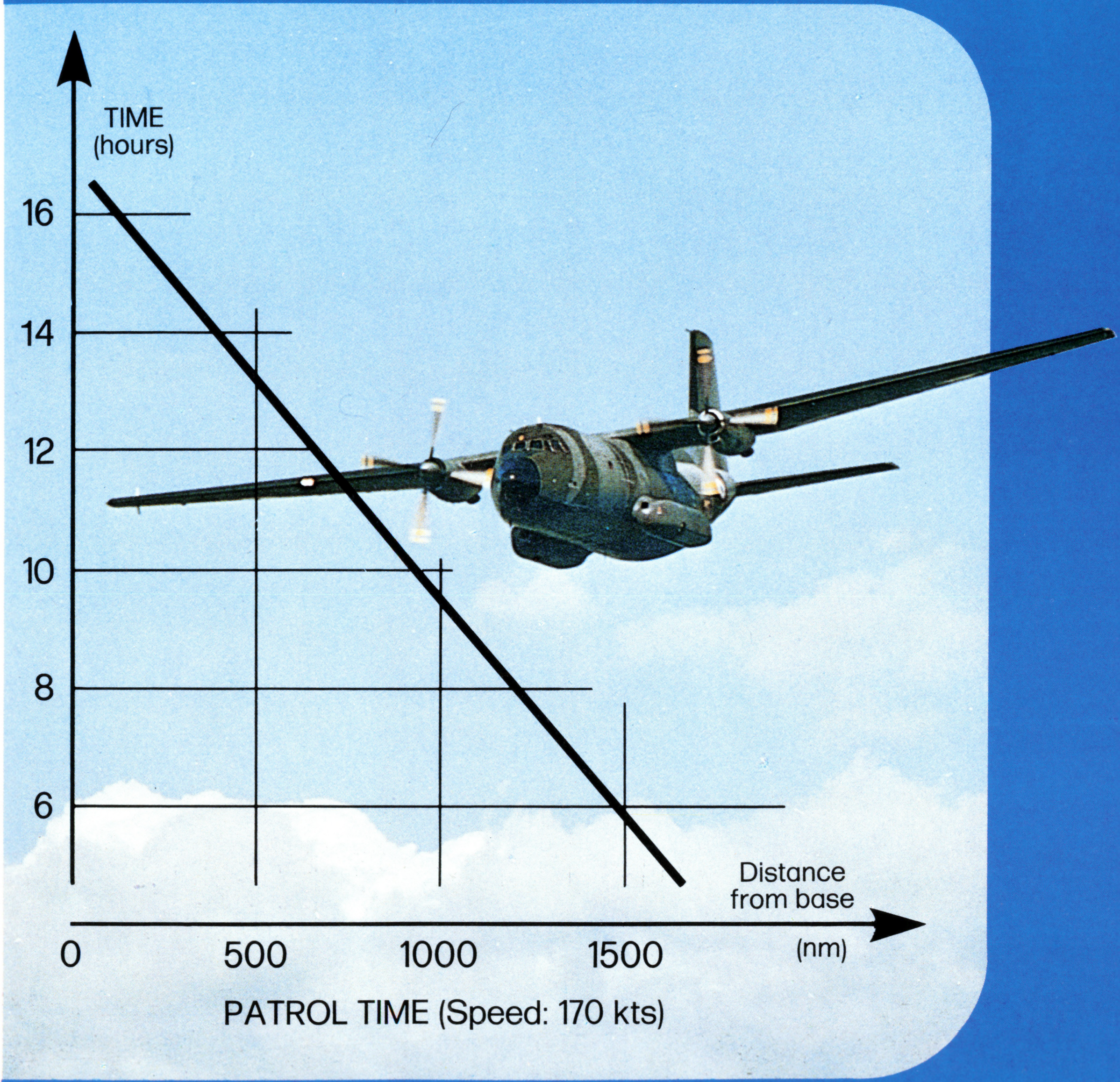
AIR International

APRIL 1981
70p
VOL 20 No 4



CHINA BOOSTS PAKISTAN AIR POWER

MARITIME SURVEILLANCE/SAR
TRANSALL C 160 S



PATROL TIME (Speed: 170 kts)

The C 160 S maritime patrol aircraft retains the basic advantages of the TRANSALL C 160 tactical transport

Société Nationale Industrielle
aerospatiale
DIVISION AVIONS
37, bd de Montmorency - 75781 Paris Cedex 16 - France

The new TRANSALL C 160 is manufactured in cooperation with MBB and VFW of Germany

AIR International

Volume 20 Number 4 April 1981

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The AIR INTERNATIONAL, De Worde House, 283 Lonsdale Road, London SW13 9QW. Telephone 01-878 2454. US and Canadian readers may address subscriptions and general enquiries to AIR INTERNATIONAL PO Box 353, Whitestone, NY 11357 for onward transmission to the UK, from where all correspondence is answered and orders despatched.

MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS ABC

Subscription rates, inclusive of postage, direct from the publishers, per year:

United Kingdom	£8·75
Overseas	£9·25
USA	$23·00
Canada	$26·00

Rates for other countries and for air mail subscriptions available on request from the Subscription Department at the above address.

The AIR INTERNATIONAL is published monthly by Fine Scroll Limited, distributed by Ducimus Books Ltd and printed by William Caple & Company Ltd, Chevron Press, Leicester, England.

Editorial contents © 1981 by Pilot Press Limited. The views expressed by named contributors and correspondents are their own and do not necessarily reflect the views of the editors. Neither the editors nor the publishers accept responsibility for any loss or damage, however caused, to manuscripts or illustrations submitted to the AIR INTERNATIONAL.

Second Class postage approved at New York, NY. USA Mailing Agents: Air-Sea Freight Inc, 527 Madison Avenue, New York, NY 10022.

ISSN 0306-5634

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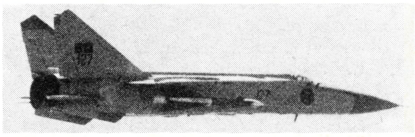

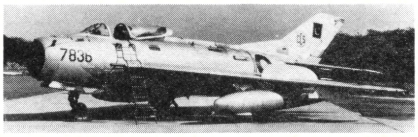

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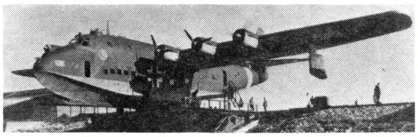

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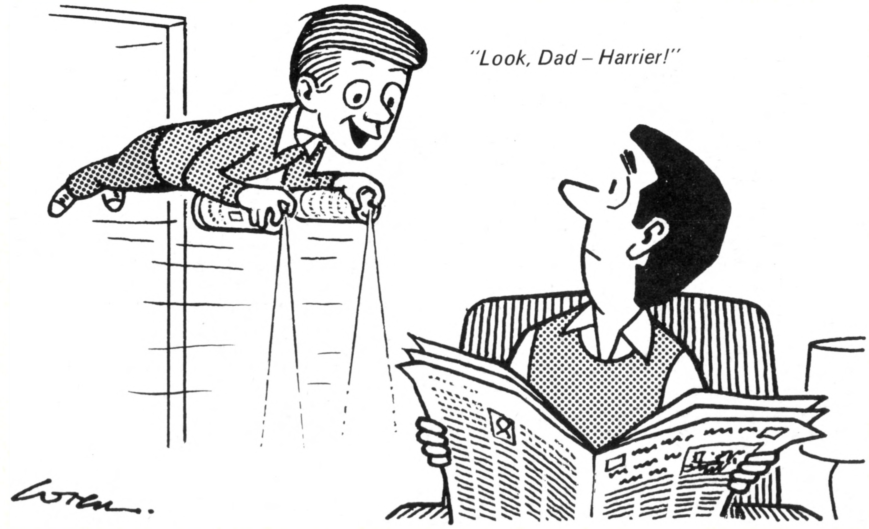
WRENDEZVOUS WITH WREN



"Look, Dad – Harrier!"

AIRSCENE

MILITARY AFFAIRS

AUSTRALIA

The RAAF was scheduled to receive final proposals by 11 February for six **business jets** for purchase or lease **to replace** the ageing **Canberra B 20s** serving in the photographic survey and target-towing rôles with No 2 Sqdn at Amberley. Contenders for the RAAF requirement include the HS 125-700, Challenger, Citation III, Falcon 50, Gulfstream III, Westwind 1 and 2, Sabreliner 65, and Learjet 35 and 55. The aircraft, which must have flight characteristics appropriate for survey work and defence-support tasks, the latter possibly including threat simulation with ECM as well as traditional target towing, are required for service from 1984.

AUSTRIA

An Austrian decision concerning a **choice of** a **fighter** with which to re-equip the Surveillance Wing *(Überwachungsgeschwader)* of the Army Aviation Force *(Heeresfliegerkräfte)* was expected shortly after closing for press. The choice to fill the 24-aircraft requirement rests between the F-16/J79, the F-16A Fighting Falcon and the Mirage 50 and hinges largely on offset or co-production arrangements. General Dynamics, which hopes that Austria will be the launch customer for the F-16/J79, has announced details of an attractive offset contracts offer involving an industrial investment and buy-back scheme which is expected to yield in excess of 800 jobs over the next decade. Although semi-official sources in Vienna have referred to the imminence of the decision, no date has *officially* been set, and some six months ago, the Finance Minister announced that budgetary considerations rendered it unlikely that an order for a new fighter would be placed before 1982.

BOLIVIA

The Dutch government recently granted **export permits for** the two **Fokker F27s** remaining against the Bolivian six-aircraft contract and embargoed last August, and these have since been delivered to the *Fuerza Aérea Boliviano* (see *Military Affairs*/February). The F27s were embargoed after the military takeover in Bolivia and released only after Fokker, with the support of the Dutch Minister for Economics, had warned the government of the damage that the company's reputation with foreign customers would suffer if it failed to complete delivery.

BRAZIL

It has been announced by EMBRAER that the *Academia de Fôrça Aérea* at Pirassununga, São Paulo, will be operating **60 EMB-312** basic trainers **by February 1984.** Two prototypes of the EMB-312 are currently under flight test, two additional airframes having been built for structural and fatigue testing, and the manufacturer's flight test programme is scheduled to be completed in June. The contract signed for the *Fôrça Aérea Brasileira* by the Ministry of Aeronautics last year apparently covers 118 aircraft, with options on a further 50, and deliveries to the FAB are to commence in the second half of next year.

CANADA

More **details** are now available **of the partial waiver** by the US government **of the R&D levy on** the **CF-18** Hornet permitting procurement of the "minimum number deemed necessary" of 137 aircraft rather than the maximum of 129 aircraft permitted by the financial target ceiling if full R&D levy was imposed. It may be viewed as an extraordinary coincidence that the complex R&D levy adjustment yielded precisely the sum necessary to procure the additional eight CF-18s and it might be suggested that the equation was begun with the requirement and worked backwards until the available funding was reached! The full R&D recoupment of $877,690 (£390,000) is being levied on the 54 CF-18s assigned to replace the CF-104s of No 1 CAG in Europe, but only a nominal $44,357 (£19,700) will be charged on each of the 83 Canadian-based CF-18s on the basis that these will be committed to the defence of the North American continent. This arrangement is presumably intended to ensure that other prospective F-18 customers will not be able to regard the partial waiver of R&D charges to Canada as a precedent.

COLOMBIA

The **Israeli government has** officially **offered** to sell 10 IAI **Kfir-C2 fighters** to the Colombian government, following the recent visit to Israel Aircraft Industries of a Colombian team led by Defence Minister Gen Louis Carlos Comacho. The *Fuerza Aérea Colombiana* is seeking to replace the AT-33s of the *Grupo de Combate* 2 and it was earlier anticipated that a further buy of the Mirage 5 was most likely in view of the previous purchase of 16 aircraft of this type for the re-equipment of *Grupo* 1 at Palanquero. However, the recent relaxation of US export restrictions on the Kfir's J79 engine, coupled with what is reported from Tel Aviv as an "extremely attractive offer to Colombia", has greatly increased the chances of FAC selection of the more efficacious Israeli fighter.

DENMARK

Controversy over **defence expenditure** has been increased by the request of Defence Minister Poul Soegaard to parliament for additional funding of DKr1,500m (£102·25m), primarily as a result of inflation in procurement of the 58 F-16 Fighting Falcons on order for the *Kongelige Danske Flyvevåben*. The programme cost of these aircraft has, according to the Defence Minister, almost doubled, primarily as a result of the Danish inflation rate and devaluation of the kroner. In real terms and in dollar value, the F-16 programme remains below the agreed ceiling unit price, and agreement has been reached with the USA for Denmark to extend its programmed payments over a longer period. While there seems little likelihood of a reduction in F-16 orders to 48 aircraft, demanded as an economy measure by the Liberal and Social Democratic parties, it would now seem equally unlikely that the *Flyvevåben* will receive the follow-on batch of F-16s for which it has been pressing and, according to the Chief of the Danish Defence Staff, Gen G K Kristensen, will now have to continue using some 20 of the F-104G Starfighters that it had planned to phase out in 1983-85 until 1986-88. The *Flyvevåben* has so far received some 20 F-16As and Bs.

EGYPT

French sources indicate that **eight** of the 30 Dassault-Breguet/Dornier **Alpha Jets** ordered for the Egyptian Air Force (see *Military Contracts*/March) will be **optimised as close-support aircraft** and essentially similar in configuration to those being supplied to the Federal German *Luftwaffe*.

FEDERAL GERMANY

The *Luftwaffe* is currently proposing the use of the **Alpha Jet for anti-helicopter operations** and has established a working group to study the potentialities of the Alpha Jet as an antidote to the growing WarPac force of Mi-8 *Hip-E* and Mi-24 *Hind-E* anti-armour helicopters. The Alpha Jet has been used successfully by the *Luftwaffe* against assault helicopters in recent trials. Specialised anti-helicopter tactics are being evolved and it is likely that a proportion of the *Luftwaffe* Alpha Jet force will also be used to counter Soviet gunships tasked with destroying NATO anti-armour helicopters which at present have no self-defence capability, relying on concealment and withdrawing when spotted.

It would now seem that cost problems have resulted in the **Defence Ministry** being forced to **abandon plans for** the so-called **TKF-90** alias ECA tactical fighter required by the *Luftwaffe* for the 'nineties. Defence Minister Hans Apel has said that, despite reluctance to abandon the plans, financial constraints are forcing Germany to look at other solutions for the *Luftwaffe*'s future fighter needs, including a possible purchase of existing aircraft (ie, the F-18). A final decision was made last month and was confirmed in Bonn as this issue was closing for press. Herr Apel has told the *Bundestag* that the development costs of the TKF-90 would alone be more than DM6,000m (£1,265m). The *Luftwaffe* is now looking at several options for replacing its F-4F Phantoms in the 'nineties. These include a modified version of the Tornado, which, it is admitted, cannot meet the dual rôle required for the TKF-90, the Northrop F-18L, the McDonnell Douglas F-15 Eagle and the General Dynamics F-16 Fighting Falcon. The last-mentioned type will meet the *Luftwaffe*'s dogfighting requirements but would not be able to fulfil completely the required all-weather air-to-ground rôle, whereas both the F-18L and the F-15 in its Strike Eagle form are likely to be capable of meeting *Luftwaffe* specifications. In the event of selection of one or other of the US aircraft, this will have to be built at least partly in Federal Germany to ensure work for the industry and will have to be timed to prevent major disruption following completion of the Tornado programme in the late 'eighties.

GREECE

The Hellenic Air Force is reportedly interested in **possible procurement of** the interdictor strike version of the Panavia **Tornado** and the type is likely to be demonstrated in Greece shortly. Federal German export laws should not affect any sale of Tornadoes to Greece as that country is currently in process of rejoining the NATO military command.

INDIA

Delivery of a follow-on batch of an unspecified number of Mil **Mi-8** *Hip* helicopters has enabled the Indian Air Force to establish an **additional squadron** on this type, No 121 Sqdn at Bombay now joining Nos 109, 118 and 119 squadrons that have operated the Mi-8 for some years.

Deliveries of the **MiG-23BN** *Flogger-F* optimised for the air-ground rôle **commenced by sea in December** — a year earlier than previously anticipated (see *Military Affairs*/November) — and, assembled mid-January, the first IAF squadron to convert to this type from the HF-24 Marut has already begun working up. A second former-Marut squadron will have converted before the end of the year, the third and remaining Marut squadron re-equipping by mid-1982. Indian contracts call for delivery of 85 *Floggers*, comprising 70 single-seat MiG-23BNs and 15 two-seat MiG-23UMs, the contract having been finalised in 1979 when it was envisaged that the first batch would be supplied in flyaway condition with subsequent aircraft being assembled at Nasik from knocked-down components. No decision has been announced concerning future procurement of the MiG-23MF air-air version of the *Flogger* which is competing with the Mirage 2000 for an IAF order entailing some 80 aircraft.

ISRAEL
The new US Administration has offered to furnish *Heyl Ha'Avir* with a **further batch of** 10 McDonnell Douglas **F-15 Eagle fighters** in order to offset concern expressed by the Begin government at the prospect of the Royal Saudi Air Force being provided by the Reagan Administration with the conformal tanks and ordnance racks for its F-15s refused by the previous Carter Administration. Israel received 25 F-15 Eagles (including two two-seat F-15Bs) from December 1976, and a follow-on batch of 15 was authorised by the Carter Administration as part of the Middle East peace package. The F-15s now being offered will raise the total of Israeli aircraft to 50, and it is proposed that these be funded by a two-year $600m (£267m) loan at a subsidised interest rate. This offer did little to mollify the Israeli government when the Reagan Administration announced its decision to accede to the Saudi request. Any further F-15 sales loans will be made at 12 per cent annual interest rate.

LIBYA
Deliveries of the Aeritalia **G.222T** to the Libyan Arab Republic Air Force (LARAF) have now **commenced** against the current order for 20 aircraft, the first G.222T having been delivered from Capodicino on 20 February and the second following on 24 February. The Libyan government is understood to hold an option on a further 10 aircraft but is reportedly currently negotiating a follow-on batch of an additional 20 G.222Ts.

MALAYSIA
The Malaysian government is now evaluating **bids** from Grumman Aerospace, the Vought Corporation and E-Systems **for the refurbishing** and modification of 48 A-4C and A-4L **Skyhawks** for the Royal Malaysian Air Force. The Malaysian government has purchased 88 surplus A-4s, and is requesting the delivery of 48 refurbished aircraft within 32 months of contract signature by cannibalising 20 others, and the provision of kits for the refurbishing of the remaining 20 in Malaysia within 42 months. Completion of the programme will result in 54 single-seat and 14 two-seat Skyhawks for the RMAF.

PHILIPPINES
The **first** of three Fokker **F27MPA** maritime surveillance aircraft ordered in July last year for operation by the Philippine Air Force was **delivered** on 30 January. Forty-two Philippine air and ground crew have been undergoing training at the Fokker Customer Training Centre at Schiphol in preparation for the operation of the aircraft, and it is anticipated that a follow-on order for a further three F27MPAs will eventually be placed.

SAUDI ARABIA
The **new US Administration** announced its decision in late February **to** the supply of conformal fuel tanks and multi-ejection bomb racks to **enhance** the capabilities of the 60 **F-15 Eagles on order for the RSAF,** despite intensive lobbying by pro-Israeli factions in the USA against providing Saudi Arabia with any offensive capability. The US is anxious not to alienate Saudi Arabia, on which it is dependent for oil, and the Saudi government has been adamant that it needs the enhanced F-15s to protect its borders in the increasingly dangerous atmosphere created by the revolution in Iran. Although the Saudi government officially denied, late February, reports of interest in the Panavia Tornado, there would seem little doubt that Saudi Arabia has informally approached Federal Germany concerning possible Tornado procurement. Federal German aerospace officials said early in February that they had discussed the possible purchase with the Saudis who had expressed interest in both the IDS and ADV versions of Tornado to meet their defence needs, the requirement being for 70-100 aircraft. Saudi procurement of the Tornado would be part of an arms package including 300 Leopard tanks, but the sale of such weapons would require significant change in Federal German arms export policy, which currently prohibits arms sales to so-called tension areas. However, despite opposition from the Social Democratic Party, the Federal German government is leaning towards the view that Saudi Arabia is a vital security link in the Middle East and Persian Gulf area. Saudi Arabia is, of course, also Germany's principal oil supplier and has agreed to make Germany a substantial loan this year to help cover Germany's current account deficit and federal budget. The Panavia partners, MBB, BAe and Aeritalia, have the capacity to build additional Tornadoes without seriously affecting deliveries to the *Luftwaffe,* the RAF and the *Aeronautica Militare,* and any sale to Saudi Arabia would undoubtedly be handled direct by the UK, although, at the time of closing for press, the UK government had received no formal approach from the Saudi government.

SOVIET UNION
According to a recent statement by the US Chief of Naval Operations, the **narrow edge** held by the US Navy over the Soviet Navy has **now** been **eliminated** by the qualitative and quantitative advances made of late by the latter. He said that one nuclear attack submarine had been commissioned in the USA last year compared with twelve attack submarines in the Soviet Union, all but four of which were nuclear powered. The US Navy has nothing in its inventory to compare with the new 22,000-ton nuclear-powered *Kirov* missile cruiser, a third *Kiev*-class V/STOL aircraft carrier is now approaching operational status, and there are now operational elements equipped with the Tu-22M *Backfire* in three of the Soviet Navy's four fleets.

According to the Fiscal 1982 posture statement prepared by the organisation of US Joint Chiefs of Staff, **more than 100 Mi-24** ***Hind-Es*** are now based **in the WarPac forward area,** with others deployed in the Far East. The *Hind-E,* which is rapidly replacing the older *Hind-D* in the anti-armour rôle, carries four AT-6 *Spiral* tube-launched, laser-homing, fire-and-forget anti-armour missiles.

AIRCRAFT AND INDUSTRY

CANADA
The stop-go progress of **Trident Aircraft** reached its fourth and probably **final "stop"** in 10 years in November 1980 as costs continued to escalate ahead of the latest funding programme. With $Can10m (£3·6m) spent already, the company estimated that another $Can8·5m (£3·06m) was needed to establish full production of the Tri-Gull amphibian at the new plant set up for the purpose on Vancouver Island. All employees have now been dismissed and survival of the project appears unlikely; the two prototypes of the Tri-Gull have been put into storage.

F/S Airlease Corp of Barrington, Illinois, became on 17 February the first US customer to **take delivery of** a Canadair **Challenger** with both FAA and Canadian certificates. The company has three Challengers on order, to add to an 11-aircraft fleet that also includes Boeing 737s, Mitsubishi MU-2s and single examples of the Swearingen Merlin, Gulfstream II and Beech Super King Air 200. Orders and deposits for the Challenger, including developed models, now total 187.

FRANCE
Aérospatiale's Helicopter Division has published details of its sales and deliveries **during 1980**, showing that the year was a particularly good one for the company. Orders for a total of 639 helicopters were recorded during the year, with a total value of Fr6,200 million (£560 million); 85 per cent of these sales were for export, in 39 countries. Deliveries during the year totalled 345 helicopters, with a value of Fr3,200 million (£289 million), 78 per cent being for export. Particular emphasis is now being placed on marketing the three new twin-engined helicopters — the 19/23-seat AS 332 Super Puma, 10/14-seat SA 365N Dauphin 2 and six-seat AS 355 Ecureuil 2/Twinstar. The last-named gained American certification on 19 January, for VFR operation by day or night; IFR certification is expected early in 1982.

The Dassault-Breguet company announced the **sale of** 41 **more Falcons** (a mixture of 10s, 20s and 50s) to its American subsidiary Falcon Jet Corporation, during February. This latest sales success brings the overall sales total for the three Falcon variants to more than 850.

INDONESIA
The **Indonesian** government has entered into a **commitment to purchase** 100 CASA-Nurtanio **CN-235** transports, and similar backing for the new project is being sought from the Spanish government. To oversee the development and production of the CN-235, the two companies have set up Air Technology Industries, and final design definition is under way. To be powered by a pair of General Electric CT7-7 turboprops, the CN-235 will have a high-wing and a cylindrical fuselage large enough to accommodate 36 passengers at 30-in (76-cm) seat pitch or a maximum of 40. There will be a rear loading ramp, as in the CASA Aviocar — sales of which by CASA and Nurtanio now total 229 — and cruising speed will be 180 kt (333 km/h).

A Memorandum of Understanding has been signed between the US and French governments covering the research, development and testing of the **CFM-56 installation for Boeing KC-135** tankers. France will share (on a percentage basis yet to be established) in the development and non-recurring production costs, in view of the intention of fitting the new turbofans on 11 *Armée de l'Air* C-135F tankers. The USAF has to date contracted with Boeing to convert one KC-135A, which is scheduled to fly in October 1982; it is then planned to convert a minimum of 100 aircraft, and possibly up to 300, about half the total USAF tanker fleet.

JAPAN
The Japanese **government** has decided **to disband** the Nihon Airplane Manufacturing Co **(NAMC)** within the next two years, in order to reduce its on-going financial commitment to the company. NAMC was formed in 1959 with 53·8 per cent government ownership in partnership with industry, and was responsible for the development and sale of 186 YS-11 twin-turboprop transports. The programme did not break-even however, and NAMC has a current deficit of some £14·6m after investment of £77·5m by the government and industry. Arrangements will be made for one of the major aerospace companies to assume responsibility for customer support of the YS-11 from early 1983 onwards; 112 of the

aircraft are currently in service, the largest operators being TDA with 42 and ANA with 34. The fleet has totalled more than three million hours.

MALAYSIA

The Malaysian government has taken delivery of a Beech **Super King Air 200T** equipped to an advanced standard **for airways calibration**. The aircraft is the first King Air 200 with strengthened wing to allow operation at weights up to 14,000 lb (6 350 kg), and incorporates a Litton LTN 76 inertial navigation unit at the heart of the navigation aid checking system. Incorporating a vertical gyro as well as the usual inertial platform, the LTN 76 can guide the aircraft down any glidepath with extreme accuracy, using one or more DME stations automatically to update the aircraft position reference and correct the inherent drift of the INS. Lateral and vertical accuracy of position fixing is claimed to be measurable in centimetres.

SOVIET UNION

New **data** has now been released **concerning** both the Antonov **An-72** *(Coaler)* **and** the **Yak-42** *(Clobber)* which are expected to be included among Soviet exhibits at the Paris *Salon de l'Aéronautique* in June. The maximum take-off weight of the An-72 (from a 4,920-ft/1 500-m runway) is now stated to be 72,751 lb (33 000 kg) and maximum useful load is increased to 22,046 lb (10 000 kg) with which range is stated to be 621 mls (1 000 km), increasing to 1,243 mls (2 000 km) with a 16,534-lb (7 500-kg) useful load. Range with maximum fuel is now claimed to be 2,360 mls (3 800 km). The maximum take-off weight of the Yak-42 has been increased to 117,945 lb (53 500 kg), maximum and normal useful loads remaining unchanged. Cruising speeds have been reduced marginally to 466-503 mph (750-810 km/h), and range with max payload has been reduced to 559 mls (900 km) at 478 mph (770 km/h) at 29,530 ft (9 000 m). Ranges with 23,148-lb/10 500-kg and 14,330-lb/6 500-kg payloads are quoted as 1,243 mls (2 000 km) and 1,864 mls (3 000 km) respectively. The practical life of the Yak-42 is claimed to be 30,000 hours or 30,000 flight cycles over a 15-year period and the service life of its Lotarev D-36 turbofan is 18,000 hours with two major overhauls.

An example of the **Kamov Ka-32** helicopter was recently put **on display** at the Moscow permanent Exhibition of Achievements of the National Economy (VDNKh). The Ka-32, which has not yet entered service, is intended to perform reconnaissance missions and search and rescue duty, by day or night in all weather, when operating from such ships as the atomic-powered ice-breakers *Lenin, Sibir, Arktika* and — still under construction — *Rossiya*. It has a range of 100 naut mls (185 km) and can carry up to 11,000 lb (5 000 kg) on the external sling.

UNITED KINGDOM

Marconi Avionics announced the completion of a satisfactory **first flight by** its **Machan** unmanned research aircraft on 19 February at the RAE Bedford. Machan (the name comes from an old Hindi word for a tree-top surveillance platform) has been jointly sponsored by the MoD and Marconi and is representative of a battlefield reconnaissance drone, with a two-hour endurance under remote control. With a span of 12 ft (3,66 m) and powered by an 18 hp Weslake two-stroke petrol engine, it can carry a 33-lb (15-kg) surveillance payload, including TV system, associated controls and data links to a ground station incorporating micro-processor-based controls. Marconi Avionics has responsibility for the payloads and the advanced attitude and motion-sensing system respectively through its Electro-Optical Surveillance Division and Gyro Division; the programme manager is the company's Flight Automation Research Laboratory at Rochester, which is also responsible for system integration and ground control equipment. The Cranfield Institute of Technology, as sub-contractor to Marconi, is responsible for the airframe, powerplant installation and flight control system. Machan is launched on a tricycle "drop-off" undercarriage and lands on skids; there is a parachute recovery system for use in emergency.

USA

The US Army has awarded Sikorsky an initial $11·4m (£5m) R&D contract to design, develop and qualify an **External Stores Support System** (ESSS) **for** the **UH-60A** Black Hawk. The system combines a number of fixed provisions built into the airframe and removable external fixtures, from which a variety of fuel tanks or weapons systems can be suspended. The R&D programme will occupy 24 months, and could be followed by production of the ESSS in 1983 if ordered by the Army. With external fuel tanks, the range of the UH-60A will extend beyond 1,000 naut mls (1 850 km); weapons options will include air-to-ground missiles such as the GD Hellfire, or gun pods, or four mine dispensers each carrying up to 80 anti-tank land mines, without degrading the Black Hawk's ability to carry troops or cargo in the cabin.

A short **first flight** was made at Stratford, Conn, on 6 February **by the Sikorsky YEH-60B**, the first of five prototype SOTAS (Stand-off Target Acquisition Systems) helicopters ordered by the US Army. A derivative of the UH-60A, the SOTAS variant has a rotating radar antenna beneath the fuselage (in mock-up form only in the first prototype) and an electronics data terminal inside the cabin; intended to observe the location and movement of enemy ground forces, the EH-60B is equipped to transmit this information back to ground station terminals for the benefit of battlefield commanders. The antenna and related electronics equipment are being developed by Motorola.

Monarch Airline's order for the **Boeing 757**, announced in London on 19 February, served to launch a **high-gross-weight version** of the new Boeing twin, not previously revealed by Boeing. Compared with the previous maximum figure of 220,000 lb (99 792 kg), the Monarch aircraft will have a gross weight of 240,000 lb (108 865 kg), representing an improvement of some 600 naut mls (1 110 km) in range with max payload. This will allow Monarch — a major IT charter operator — to fly non-stop services on such routes as Luton or Glasgow to Tel Aviv, and Aberdeen to Tenerife. To match the higher weight, more powerful versions of the Rolls-Royce RB.211-535 have also been specified; initially, these will be -535Es, which are basically the current 37,400 lb st (16 965 kgp) -535C (as specified by British Airways and Eastern when the Boeing 757 was first ordered) but running at higher temperatures to produce 40,000 lb st (18 144 kgp). From late 1984 onwards, however, Rolls-Royce will provide the 40,100 lb st (18 190 kgp) -535E4 (see *Airscene*/March 1981) which has new engineering features to achieve lower sfc despite the higher thrust. Monarch is the first airline to specify the -535E4, although Rolls-Royce is discussing with BA and Eastern the possible use of this uprated engine in some of those airlines' Boeing 757s.

Flight **testing of** the Gulfstream American **Hustler 500** began late in January at Van Nuys, California, and is continuing at Mojave. This second Hustler prototype (the Hustler 400 first flew in 1978) is powered by a 900 shp Garrett AiResearch TPE 331-10-501 turbojet in the nose and a 2,200 lb st (1 000 kgp) Pratt & Whitney JT15D-1 turbofan in the tail, but the mixed power plant philosophy — originated by the American Jet Industries company before it acquired Grumman American and, more recently, Rockwell's General Aviation Division — is likely to be abandoned by Gulfstream American in favour of a more conventional twin-engined arrangement with two turbofans of about 1,500 lb st (680 kgp) each side-by-side in the rear fuselage. In this guise, the biz-jet is expected to be renamed Peregrine 2; the Peregrine 1 is the private-venture military trainer powered by a single JT15D-4 and with a two-seat side-by-side cockpit in place of a corporate-type cabin. Both the Hustler 500 and Peregrine 1 are expected to be exhibited by Gulfstream American at the Paris Air Show in June.

The No 2 **YAV-8B**, modified by McDonnell Douglas from a British-built AV-8A Harrier, has recently been **fitted with leading-edge root extensions** (LERX) of the type already test-flown on a Harrier GR Mk 3 under MoD contract (see *"Big Wings from Kingston"*/September 1979). The LERX serve to increase the turn rates of the AV-8B from a figure of about 14 deg/sec to at least 16 deg/sec, which goes some way to meeting one of the key RAF requirements for an enhanced Harrier. The modified aircraft has been flown by British pilots at St Louis as part of the continuing investigation of the AV-8B versus the British Aerospace Harrier 5, and other possible new features for any aircraft purchased by the RAF have also been discussed, including the addition of a manoeuvring flap and sealing of the trailing edge flaps to improve airflow. McDonnell Douglas also has developed some drag-reducing features since the YAV-8B first flew. Although the production future of the AV-8B has still to be clarified by the Reagan Administration, Marine Corps enthusiasm for the type is undimmed and there is growing US Navy interest. Work proceeds meanwhile on the four new-build AV-8Bs already funded as the first step towards production, and under the terms of the BAe/MDC co-production agreement, the first UK-manufactured fuselage section for these aircraft was delivered on schedule during February.

Rockwell International's North American Aircraft Division has submitted to the USAF details of its proposed Long Range Combat Aircraft (LRCA), which is a further stage in development of the company's Multi-Rôle Bomber (MRB), itself an outgrowth of the supersonic, swing-wing bomber. The Rockwell LRCA is one of the options under study by the new US Defence Secretary to provide **SAC** with an **interim manned bomber**, pending the development and production of a completely new bomber with "low observability" through the use of materials and design techniques offering a very small radar cross-section, as already demonstrated on the Lockheed "Stealth" aircraft. Alternative interim proposals are to produce the B-1 with little modification, or a stretched General Dynamics FB-111 (by converting F-111A fighters). To provide a suitable power plant for any of these bombers, the USAF has funded initial full-scale development of the General Electric F101-GE-102 turbofan, developed from the -100 version that powers the B-1 prototypes.

Bell Helicopter has joined forces with McDonnell Douglas, Northrop and Sperry **to participate in** the US Army's competitive Army Helicopter Improvement Program **(AHIP)** aimed at producing an improved scout helicopter in the near-term. Bell will base its submission on the existing OH-58 Kiowa, with modifications including a mast-mounted sighting system by McDonnell Douglas Astronautics Co, a TV telescope, FLIR and targetdesignating laser by Northrop's Electro-Mechanical Division, and visual control, display and multiplex systems by Sperry Flight Systems.

Certification of the **Learjet Longhorn 50** series of biz-jets was **expected** during March (after this issue closed for press) according to a briefing provided by Gates Learjet for more than 150 corporations that have contracted to buy either a Model 55 or Model 56 (the Model 54 has been dropped — see *Airscene*/December 1980). The fourth 50-series Longhorn flew on 3 February at Tucson, and nearly 20 aircraft are now in various stages of final assembly; the first aircraft, a Model 55, had meanwhile completed more than 400 hours on over 300 flights. All necessary natural icing tests for certification have been completed, as have noise tests (showing levels below the required limits), runway water ingestion tests, emergency descents and an extensive stall programme. The static test airframe is well into the pressure cyclic test programme, with more than 50,000 pressure cycles completed, including two to 25 lb/sq in (1,76 kg/cm²) and several fail-safe tests.

Composite Aircraft Corp, of Florence, Kentucky, has given details of its plans to produce three **derivatives of** the all-plastics **Windecker Eagle**, the design and production rights for which were acquired after Windecker Industries Inc went bankrupt. The four-seat high performance Eagle, of glassfibre and epoxy construction, had been certificated by Windecker and six examples were built; two of these are now owned by Jerry Dietrick, president of CAC. The planned developments are Eagle 1, with the same 285 hp Continental IO-520-C engine as the original model but an improved one-piece tapered wing with winglets and a single spar in place of the three-piece rectangular five-spar wing; Eagle 2, combining this new wing with a 317 shp Allison 250-B17C turboprop and Eagle 3, with a new fuselage incorporating a six-seat pressurised cabin and turboprop engine. One of the original Eagles is at present being fitted with an Allison turboprop to help development of the Eagle 2.

Saudia's choice of Pratt & Whitney **JT9D** engines to power its fleet of Airbus A300B4-600s, confirmed early in February and noted briefly in our previous issue, serves to launch a new, **more powerful version** of that engine, the 56,000 lb st (25 400 kgp) JT9D-7R4H1. This variant of the -7R4 engine family is expected to be certificated by September 1982, and delivery of the A300s to Saudia is to begin in April 1984. The first two models of the JT9D-7R4 have already been certificated, at 44,300 lb st (20 100 kgp) and 48,000 lb st (21 770 kgp), using eight development engines that accomplished 5,951 test hours; these variants are for use initially in Boeing 767s (specified to date by Air Canada, Alaska, Avianca, Braathens SAFE, China Airlines, El Al, Pacific Western, TWA, United and Western) and Airbus A310s (specified by SAS, Sabena and Austrian). A 50,000-lb st (22 680-kgp) version of the JT9D-7R4 is on offer for Boeing 767 and A310 variants, and a 54,750-lb st (24 835-kgp) version has been ordered by Swissair for its Boeing 747SUD aircraft. Growth versions up to 60,000 lb st (27 215 kgp) are projected.

A General Electric **CF6-80A** turbofan, of the type intended to power some versions of the Boeing 757, has **entered flight test**, mounted on the inboard port position of the Boeing-owned 747 prototype. This aircraft previously was used for an initial 40-hr flight test programme with the JT9D-7R4, development of which is now being continued on a Boeing B-52 (see *Airscene*/March 1981).

Piper Aircraft has adopted the name **Sequoya** (so spelt, rather than the more usual Sequoia) for a new production **version of** what was the **Smith Aerostar**. The specification of the PA-60 Sequoya 602P is almost identical with that of the Aerostar 601P, but a change of engine variant achieves a greater range at a reduced cruising speed, a better rate of climb on one or two engines, a better service ceiling and improved take-off performance. Introduction of a turboprop version of the Sequoya is thought to be likely in due course. A **new version of** the **Seneca** twin also has been introduced by Piper, with 220 hp Continental engines in the Seneca 3 replacing 200 hp engines in the Seneca 2, giving higher cruising speeds, climb and take-off performance.

CIVIL AFFAIRS

BELGIUM

The Belgian Ministry of Transport has taken **delivery of** the five EMB-121 **Xingu** turboprop twins **for** use at the civilian pilot **training school** that is operated at Grimbergen by Sabena on behalf of the Air Administration Department of the MOT. They replace six Cessna 310s that have been in continuous operation since 1957, supplementing the nine Siai Marchetti SF-260s used for elementary training. Purchase of the Xingus was linked with the granting of landing rights for Sabena at Rio de Janeiro, but operation of a South American service would require the Belgian airline to add one DC-10 to its present fleet, and in view of present financial difficulties, it has no plans to do so.

Sabena has signed a three-year **wet-lease** agreement with Delta Air Transport of Antwerp covering three **of** the latter's four **Fairchild FH-227s.** Starting 1 April, these are being flown on Sabena routes from Liege to London and Brussels to Dusseldorf and Amsterdam, under the terms of an agreement between Sabena and the Walloon regional authorities (see *Airscene*/May and September 1980). The Liege-London operation replaces that operated by Aspair using Swearingen Metros, and the latter's operation of the uneconomic Charleroi-Ostend-London routes is being abandoned. From 1 April 1982, Sabena flight crews will take over from Delta crews on the FH-227s, and the state airline is also responsible for maintenance of the aircraft. The fourth Delta FH-227 is operated on behalf of the Dutch NLM on the Antwerp-Amsterdam route.

Aspair and European Air Transport (EAT), third-level operators using Swearingen Metros, have joined forces to form a **new commuter-airline, Air Commuter**. With offices in Brussels, the company is maintaining its facilities at Zaventem and Gosselies, and is seeking international regional traffic rights in accordance with EEC policy and in the face of Sabena's legal monopoly of such rights within Belgium.

INDONESIA

The Indonesian Civil Aviation Training Centre at Curug has taken **delivery of** the **first** Nurtanio-built **NC-212** Aviocar **Srs 200**, one of two ordered for use at the CATC by the Directorate General of Air Communications. The aircraft are to be used at the CATC for the training of pilots needed to implement Indonesia's third five-year plan in respect of the development of pioneer and regional air services. As part of this plan, the DGAC also has ordered 12 NC-212 Srs 200s for operation by Merpati Nusantara Airlines in areas of Indonesia not at present well-served by air services.

SOVIET UNION

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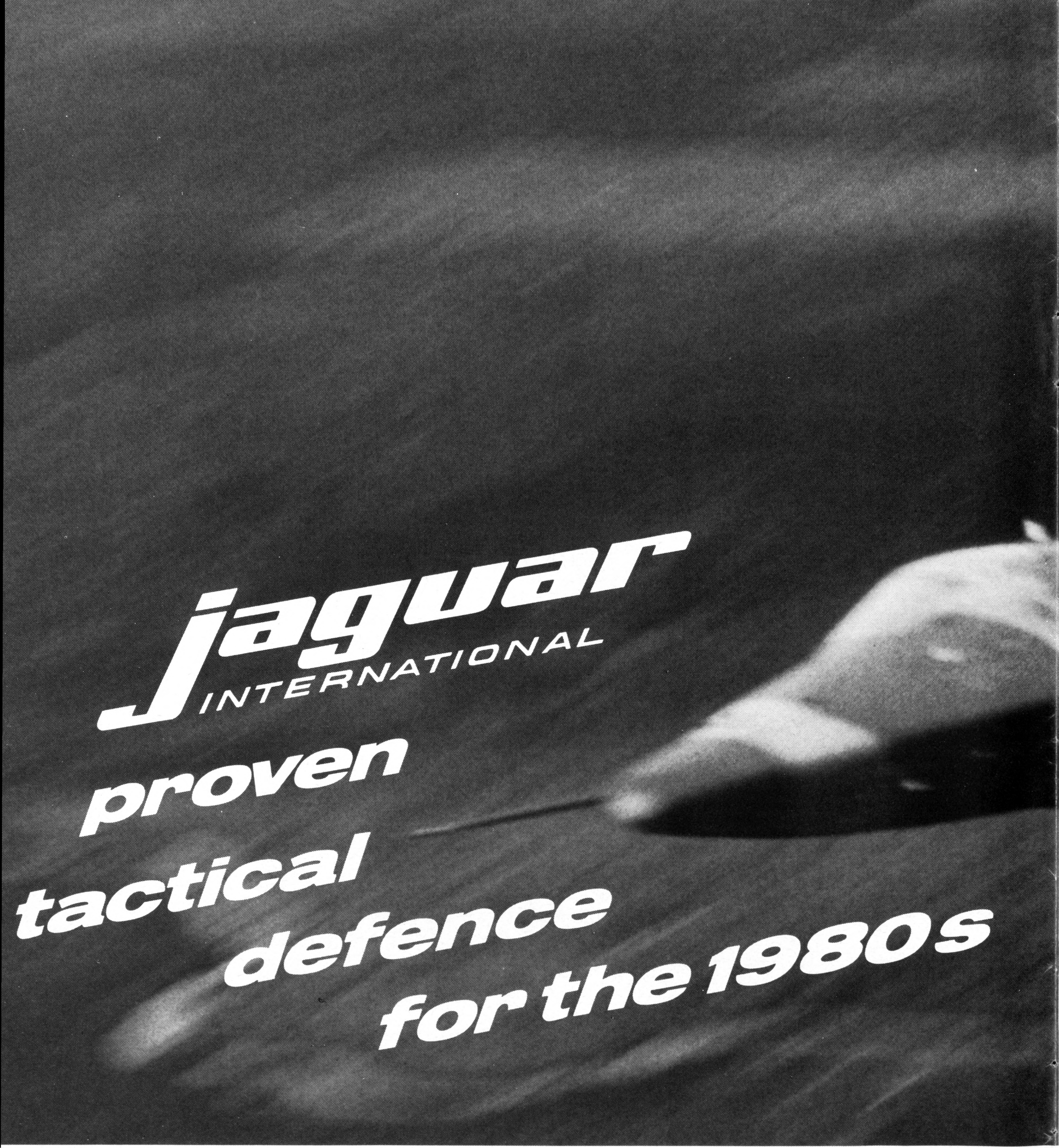

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Soviet Union remains unfulfilled, according to V Belozerov, chief engineer of the Directorate for the employment of aviation in the national economy. Prolonged evaluation of the PZL M-15 Belphagor jet biplane developed in Poland in conjunction with Soviet engineers has proved unsuccessful and the aircraft is unsatisfactory in a number of technical, economical and operational aspects, according to Belozerov. Alternative new ag-planes are now being considered, among them a turboprop derivative of the An-2 itself; a prototype of such a design was built some years ago, reportedly with the designation An-3, but appears to have been passed over in favour of the M-15. In the five-year period 1976-1980, Aeroflot agricultural aircraft worked a total of 464 million hectares, the 1980 total passing the 100 million mark for the first time in a single year. Helicopters (principally the Mi-2 and Ka-26), covered some 12-15 million hectares of orchards, vineyards and vegetable crops, but were able to satisfy less than one-third of the demand for their services; a new agricultural helicopter has been under study for at least 10 years, but with no results to date.

UNITED KINGDOM

Three- and four-week **package holidays** combined **with** 40 hrs of **flying training** at an FAA-approved flying school in the Las Vegas area, plus a comprehensive ground school course, are being offered by Brook International Aviation School (BIAS), a member of the Fireguard group of companies. The scheme is indicative of the growing opportunities for British and European student pilots to learn to fly in the USA at competitive rates (see also this column last month) and without the restraints of the UK climate. The BIAS package costs less than £1,500 inclusive of air travel and accommodation, and provision is made for a pre-departure course of ground training in the UK and for subsequent membership of BIAS's UK flying club and reduced-rate flying. Additional details are available from BIAS at 32 Muswell Hill, London N10 3TA (Telephone: 01-444 0895).

USA

Although the projected **merger between Continental and Western Airlines** has received the support of the CAB's legal department and final approval appears to be no more than a formality, both companies have recently been the subject of unwelcome take-over bids — from Texas International and from UNC Resources respectively. Texas International will be remembered as a bidder for National Airlines in 1978, in competition with Pan American (which was finally successful). The Texas company, which has a large fleet of DC-9s operating in the US and to Mexico, and has also recently set up New York Air, has acquired about 10 per cent of Continental through private share deals and is now offering to buy other shares to build up its holding.

Flying Tiger Line has **formed** a wholly-owned passenger charter operator named **Metro International Airways.** With headquarters in New York, the company will use three ex-Singapore Airlines Boeing 747s and in the first instance is expected to operate under Flying Tiger rights on routes from New York to Paris, Frankfurt and the Benelux countries.

After some delay in the original programme (see *Airscene*/January 1981) **Pan American** finally re-launched its **US-China** air **service** on 28 January, when a Boeing 747SP named *China Clipper* left New York with 97 passengers and 20 crew. The service to Beijing (Peking) operates by way of Tokyo once a week, with a second weekly flight by way of San Francisco and Shanghai; a third weekly flight on the latter route will be added at the end of April.

CIVIL CONTRACTS AND SALES

Aérospatiale Caravelle: Between the end of this year and October 1983, Air Inter will take delivery of the last four Caravelle 12s from Sterling, bringing the French domestic operator's fleet of Super Caravelles to 12 (including one ex-Sterling already delivered). Consequently, the six Caravelle IIIs remaining in the Air Inter fleet will be retired progressively.

Aérospatiale N 262B: Two N 262Bs have been acquired by the Swiss operator Rhineair of Basle for regional services.

Airbus A300: Saudia has leased two A300B4-100s from Korean Air Lines, (which has a fleet of six); both are now operating in Saudia livery. They will be returned off-lease later this year.

Boeing 737: Monarch Airlines has ordered two high-gross-weight Advanced 737s for spring 1982 delivery and has put into operation two similar aircraft on lease from Bavaria (but delivered direct to Monarch off the Boeing line); the leased aircraft are used primarily on the company's flights out of Berlin. □ Britannia Airways, with a fleet of 20 Boeing 737s and three on order, has leased two more for its 1981 operations — one from Eagle Air of Iceland and one from Transavia. □ One of two Boeing 737s chartered by Britannia to Ellerman Sunflight is to be used, starting next November, for a once-a-week flight between Glasgow and Larnaca, Cyprus via Milan on wet-lease to Cyprus Airways. □ Far Eastern Air Transport has acquired five 737-100s from Lufthansa. □ Alaska Airlines ordered two more 737s.

Boeing 757: Monarch Airlines has ordered two high-gross-weight versions with RB.211-535E/E4 engines (see separate news item) for spring 1983 delivery with an option on two more for 1984.

Boeing 767: El Al has selected Pratt & Whitney JT9D-7R4 engines for its four 767s to be delivered August 1983-March 1984 (this column last month).

British Aerospace BAe 146: The original order for three BAe 146s placed by Argentinian carrier LAPA has been downgraded by British Aerospace to the status of an option because LAPA is "experiencing difficulty in obtaining a licence to operate the routes on which it plans to use the aircraft". An order for two aircraft by a US company which was announced in September 1980 is "dependent on satisfactory financing arrangements being concluded", says BAe.

Canadair Challenger E: Executive Air Fleet International, based at Teterboro, New York, is reported to have placed a firm contract for 10 Challenger Es, for 1984/85 delivery. The company already has six standard Challengers on order.

EMBRAER EMB-110 Bandeirante: Aires Colombia, a new commuter airline, has taken delivery of two EMB-110P1s and has begun operation on routes out of Bogota. Options have been taken on a third Bandeirante for August delivery, and an EMB-120 Brasilia.

Fairchild Swearingen Metro: A Metro II has been acquired by German operator Nurnberger Flugdienst to operate a service between Nuremberg and Paris.

Fokker F 27: Air Zaïre ordered four Mk 500s for March-September 1982 delivery. They will have 44 seats plus cargo in a mixed traffic configuration.

Fokker F 28: Pelita Air Service of Indonesia has ordered its seventh F 28, a Mk 4000 for October 1981 delivery. □ Fokker announces the sale of six more F 28s to "several undisclosed customers" to bring the order book to 171 for 45 operators in 30 countries. Altair in the USA is believed to be one of the customers concerned, having converted options on three to a firm contract.

Gulfstream American Gulfstream 1-C: Air US, flying third-level services out of Denver, has ordered one Gulfstream commuter, for May delivery.

Lockheed L-1011 TriStar: Delta confirmed an order for one more L-1011-1, for January 1983 delivery, to bring its fleet to 43. □ All Nippon Airways sold two L-1011-1s to Guinness Peat Aviation (for lease to other operators) as part of its planned fleet development with introduction of Boeing 747SRs.

Saab-Fairchild 340: Swedair AB, which was recently nominated by a Swedish government committee to become responsible for a third-level network in Sweden, has placed an order for 10 SF 340s. Delivery will be made from July 1984 to May 1986 and the contract is valued at approx SKr200m (£19·6m) including initial spares backing.

Shorts 330: Alidair placed an order for two Shorts 330s, for scheduled and charter services within the UK mainland and to the Channel Islands. The company has adopted the name Inter City Airlines emphasising its greater concentration on commuter-type operations. (See also Shorts 360, below.)

Shorts 360: Alidair is the first UK customer for the new Shorts commuter-liner, with an order for two plus two on option, for delivery in 1983. (See also Shorts 330, above.)

Westland WG 30: British Airways Helicopters has confirmed its intentions, announced during the Farnborough Air Show, by ordering two WG 30 helicopters, in 17-passenger configuration. The order is the first for the WG 30, derived from the Lynx; delivery will be made late-1981 and April 1982, and initial operations will be on the Penzance-Isles of Scilly route, plus possibly on the planned BAH route between Milton Keynes and London Heathrow.

MILITARY CONTRACTS

Cessna 421: The RNZAF has placed a contract valued at $NZ2·4m (£1m) for the supply of three Cessna 421s to replace the DH Devons that remain in service with No 42 Sqdn at Ohakea.

Helibras Gaviao: The *Fuerza Aérea Boliviano* has placed an order valued at $6·5m (£2·9m) with Helibras for six Gaviao (Brazilian licence-built version of the SA 315B Lama) helicopters. Three of these are to be delivered next month (May) and the remaining three before the end of the year.

Lockheed L-100-30 Hercules: The government of Dubai has purchased an L-100-30 Hercules in a contract valued in excess of $12m (£5·3m). The aircraft, which is to be used by the Dubai Air Wing of the Air Force of the United Arab Emirates, was delivered in January.

McDonnell Douglas KC-10 Extender: On 13 February, the USAF signed a contract valued at $284m (£126m) for a follow-on batch of six KC-10 Extender tanker/cargo aircraft. This order brings the total number of KC-10s so far ordered to 12 against current long-term plans for a total of 32 aircraft.

PROBLEMS FOR PAKISTAN'S AIR POWER

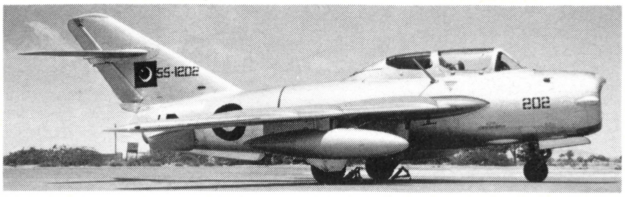
John Fricker reports from PAF HQ and some operational bases

SELDOM has there been a more threatening period in Pakistan's turbulent 33-year history than the present time. Apart from internal political problems, reflected by the three-year imposition of martial law by the military administration of President Zia ul-Haq, the Soviet occupation of Afghanistan has necessitated a reorientation of Pakistan's defence posture and responsibilities. This has been accentuated by the military reinforcement by some 20,000 Soviet mountain troops of the Wakhan Strip, along the Hindu Kush, which in effect gives Pakistan a common border with the USSR. It also represents a potential threat to the tenuous Karakoram Highway which links Pakistan with its main benefactor, the People's Republic of China.

Traditionally, Pakistan has remained geared since its formation to confrontation with India, and progress towards the possible achievement of political agreement between the two countries appears to have been set back by Prime Minister Indira Gandhi's revival of the contentious Kashmir dispute. While accusing Pakistan of military expansion, India has embarked on a major re-equipment programme, particularly

(Below) An FT-6, the Chinese-developed two-seat version of the MiG-19, in service with No 25 Squadron (OCU) of the PAF at Sargodha. (Heading photo) A pair of F-6 fighters of No 19 Squadron (Cobras) from Peshawar, flying over the Karakoram Mountains in Northern Pakistan.

(Above) Shenyang-built FT-5s in formation. The FT-5 is now the PAF's standard advanced trainer, replacing the T-33. (Below) An FT-5 of the PAF Fighter Conversion Unit at Mianwali.



for the Indian Air Force (IAF), which will introduce a new level of sophistication and offensive capability into the sub-Continent from the scheduled and imminent procurement of such advanced multi-rôle and strike aircraft as the Mach 3 MiG-25 *Foxbat*, the MiG-23BN *Flogger* and the Jaguar in very substantial numbers.

Since the Pakistan Air Force (PAF) already finds itself outnumbered by a factor of three by the IAF's 39 combat squadrons, Indian re-equipment is regarded as a serious threat to Pakistan, which, despite claims to the contrary from Delhi, is unable to indulge in an arms race because of severe budget limitations. In particular, the Defence Ministry in Islamabad has formally refuted Indian claims concerning the alleged supply to the PAF of three squadrons of Nanchang-built A-5 *Fantan-A* ground attack aircraft and SAMs from China by the end of this year.

In the same report, India further claims that the PAF is building 12 new air bases to supplement about 40 already in operation, and has installed a new air defence network comprising six Westinghouse TPS-43 mobile three-dimensional radars. It is also alleged in India that 50 Pakistani pilots have received training on Northrop F-5Es, and that the PAF could activate at short notice three squadrons of these fighters currently operated by "three West Asian countries." Other equipment said to be sought from the US by the PAF, includes additional C-130s, Hughes 500MD, Bell AH-1 and Boeing Vertol CH-47 helicopters, and AGM-65 Maverick, AIM-9L Sidewinder, GD Redeye, Hughes TOW and

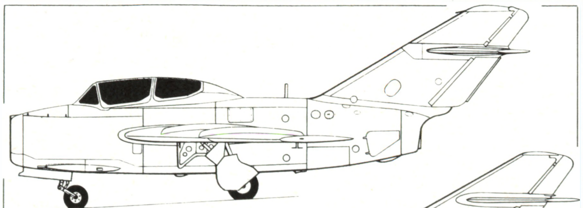
THE FT-5 AND FT-6

It is curious that two advanced trainers which have been in production in China for several years have hitherto remained little known to the West, despite having been exported to at least two Middle Eastern countries. Only very recently has the Chinese-developed two-seat version of the MiG-17, built at Shenyang and designated the FT-5, emerged from complete obscurity, rarely having been previously illustrated in the West, although it has been in service with the Pakistan Air Force for the past five years! Similarly, although of more recent origin, the two-seat Shenyang development of the MiG-19SF, the FT-6, is not widely known, despite service with Egypt as well as Pakistan.

Development background of these trainers must remain largely speculative, in view of their birthplace, but they provide some interesting pointers towards Chinese aeronautical progress. As the earlier of the two designs, the FT-5 appears uniquely Chinese, in that no similar two-seat conversion of the MiG-17 ever appeared in the Soviet Union.

The FT-5 is clearly based on the two-seat MiG-15UTI, or FT-2, built in very large numbers in both the USSR and the People's Republic of China, and as a modification of the early MiG-17, with a non-afterburning Klimov VK-1 centrifugal turbojet derived from the Rolls-Royce Nene (designated TJ-5D by the Chinese), and developing only 5,952 lb (2 700 kg) thrust for take-off, offers little more in the way of performance. It remains firmly subsonic, with no transonic capability — limiting speed is around Mach 0·92 — and has a fixed rather than all-moving tailplane, which is presumably why the Soviet Union did not bother to develop a trainer version.

Comparative views of the MiG-15UTI (upper) and the Shenyang FT-5, the Chinese-developed two-seat version of the MiG-17.



Although the forward and centre (ie, forward of the rear frame of the engine plenum chamber) fuselage of the FT-5 remains essentially similar to that of the MiG-15UTI, which must have simplified the two-seat conversion, the rear fuselage of the MiG-17 is lengthened 35·4 in (90 cm), the tailplane sweep is increased and the wing is substantially different, with a consequent major improvement in handling. The MiG-15UTI suffers, as the author recalls from an earlier handling flight in Pakistan, from fairly pronounced pitch-up tendencies at high angles of attack, and could not be classed as a forgiving aeroplane, so far as training is concerned. The thinner and almost crescent wing of the MiG-17, with inner leading-edge sweep of 45 deg reducing to 42 deg on the outer panels, plus three large and strategically-placed fences appears, from a brief evaluation flight in a PAF FT-5, to result in much "softer" and less critical handling characteristics.

Cockpit arrangement, both internally and externally, seems basically similar to that of the MiG-15UTI alias FT-2, a few of which remain in PAF service for instrument training. In Pakistan, the FT-5 began replacing the Lockheed T-33 and F-86F Sabre for advanced training in early 1975, and now equips the Fighter Conversion Unit at Mianwali, where "wings" graduates from the PAF Academy complete around 100 sorties averaging about 45 minutes each before moving on to an Operational Conversion Unit.

The FCU course includes basic weapons training, for which the FT-5 is equipped with a single 23-mm Nudelman-Rikhter cannon under the starboard nose for air-to-ground gunnery, apparently in conjunction with a radar-ranging sight through a di-electric antenna in a small radome above the intake. Over the past five years, the FT-5 has gained a reputation in the PAF as a sturdy and reliable trainer with a lower wing loading than the T-33. It offers more restricted visibility for the instructor in the rear seat, however, as well as somewhat less endurance and a much lower engine overhaul life of only 200 hours. Although so far identified in foreign service outside China only in Pakistan, the FT-5 has been built in substantial numbers and could well appear in other overseas air forces operating Chinese-supplied aircraft.

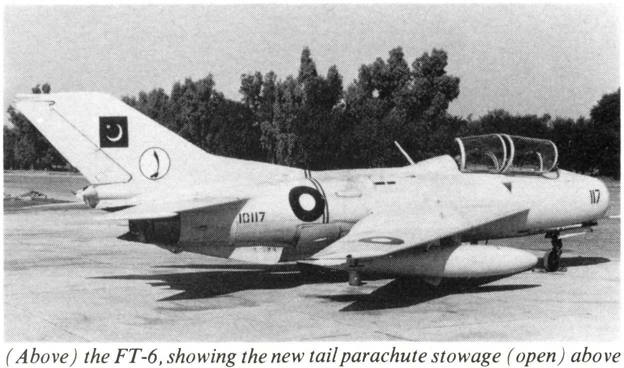
Wing span of the FT-5 is similar to that of the single-seat MiG-17 *Fresco-A* at 31 ft 7⅛ in (9,63 m), but length is marginally increased to 37 ft 7⅕ in (11,46 m), overall height remaining at 12 ft 5⅝ in (3,8 m). Max level speed is quoted by the PAF as 486 knots (902 km/h) at 32,000 ft (9 753 m), service ceiling as 45,000 ft (13 715 m), and max endurance at that altitude as 2 hr 38 min with two 88 Imp gal (400 l) drop tanks.

Although the Soviet Union built a small number of MiG-19UTI two-seat trainers, the V-VS concluded that a two-seat MiG-19 conversion trainer was unnecessary for transitioning

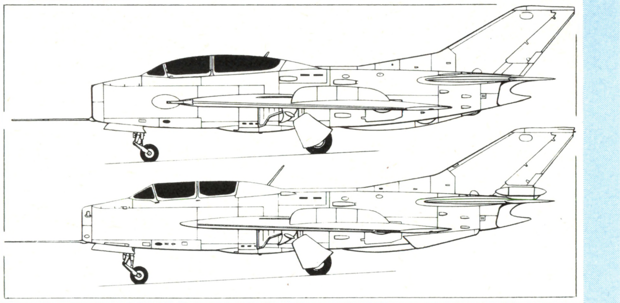
Raytheon Improved Hawk missiles. In fact, a $200m offer of American military aid to Pakistan made early last year was rejected by President Zia.

Further US aid to Pakistan is limited by the Symington Amendment to the Foreign Assistance Act, barring military help to countries believed to be developing nuclear weapons, although such intention has been denied by the government in Islamabad. The US restrictions do not, however, extend to commercial sales of arms and equipment through Foreign Military Sales Programmes, although, on this basis, Pakistan's defence budget would not extend to any significant American arms procurement without external assistance. This could possibly be forthcoming if reports become substantiated that Saudi Arabia is considering supplying $750m for arms funding in return for the transfer of PakArmy troops for training and guard duties in the desert kingdom. The PAF would then become an obvious potential customer for something like the GD F-16/79 or Northrop F-5G, in which it is already displaying some interest.

From a visit to the PAF and interviews with its Chief of Air Staff, Air Chief Marshal Muhammad Anwar Shamim, and other air staff officers, base commanders and pilots, it is evident that if only half the Indian claims as to its expansion were true, Pakistan would have far fewer air power problems than are currently apparent. With only eight or nine squadrons of F-6 (Chinese-built MiG-19SF) short-range air superiority fighters and four of Mirage IIIs and 5s for all-weather interception, tactical reconnaissance and ground attack, the



(Above) the FT-6, showing the new tail parachute stowage (open) above the tailpipes, and additional two strakes beneath the fuselage (Below) The author (rear cockpit) with Wg Cdr Dotani, CO of No 14 Squadron, in an FT-6.



Comparative views of the Soviet-developed two-seat MiG-19UTI and the Shenyang-developed FT-6, which has a longer fuselage.

and production was terminated, and the Shenyang-built FT-6 appears to owe little or nothing to its Soviet predecessor. Whereas the Russian tandem two-seat modification was accommodated within the existing fuselage, the forward section of the FT-6 was lengthened by some 33 in (84 cm) over the original 41 ft 4 in (12,6 m), (without the long nose pitot) by the Shenyang design team to allow room for the second occupant. This necessitated the addition of two more ventral strakes beneath the rear fuselage as compensatory side area to prevent snaking, giving the FT-6 a total of three strakes in all.

Other differences from the standard F-6 are few, although, in view of the already very limited endurance, to make up for the loss of fuel capacity resulting from the second cockpit, extra tankage had to be provided. A prototype two-seater appeared with small tip-tanks to rectify this deficiency (see February 1980 issue, page 101), but these apparently proved unacceptable on a 58-deg (leading edge) swept-wing. The solution adopted on production FT-6s was to remove the two massive 30-mm NR-30 wing-root cannon and insert extra fuel tanks in their bays, leaving only the single similar weapon under the nose for armament training. This leaves the FT-6 with only 150 or so litres (33 Imp gal) less fuel than the single-seat version and allows a safe average training sortie time of about 45 minutes.

With the same twin Tumansky RD-9B-811 (WP-6) axial-flow turbojets as the single-seat F-6, with a military rating of 5,732 lb (2 600 kg) each, or 7,165 lb (3 250 kg) with reheat, the FT-6 offers virtually identical performance and handling to the F-6, with a maximum limit speed of around Mach 1·25-1·4, and a nominal low-level supersonic capability in the clean configuration of some 723 knots (1 340 km/h). At a gross weight of around 19,274 lb (8 742,5 kg), with two 167 Imp gal (760 l) drop tanks, the F-6 has a thrust/weight ratio of 0·86:1, and outstanding acceleration and manoeuvrability up to medium altitudes, as graphically demonstrated to the author during an FT-6 flight from Mianwali. The F-6's low-speed stability and handling are somewhat critical, particularly for inexperienced pilots, and the requirement for a two-seat version for conversion training is therefore logical.

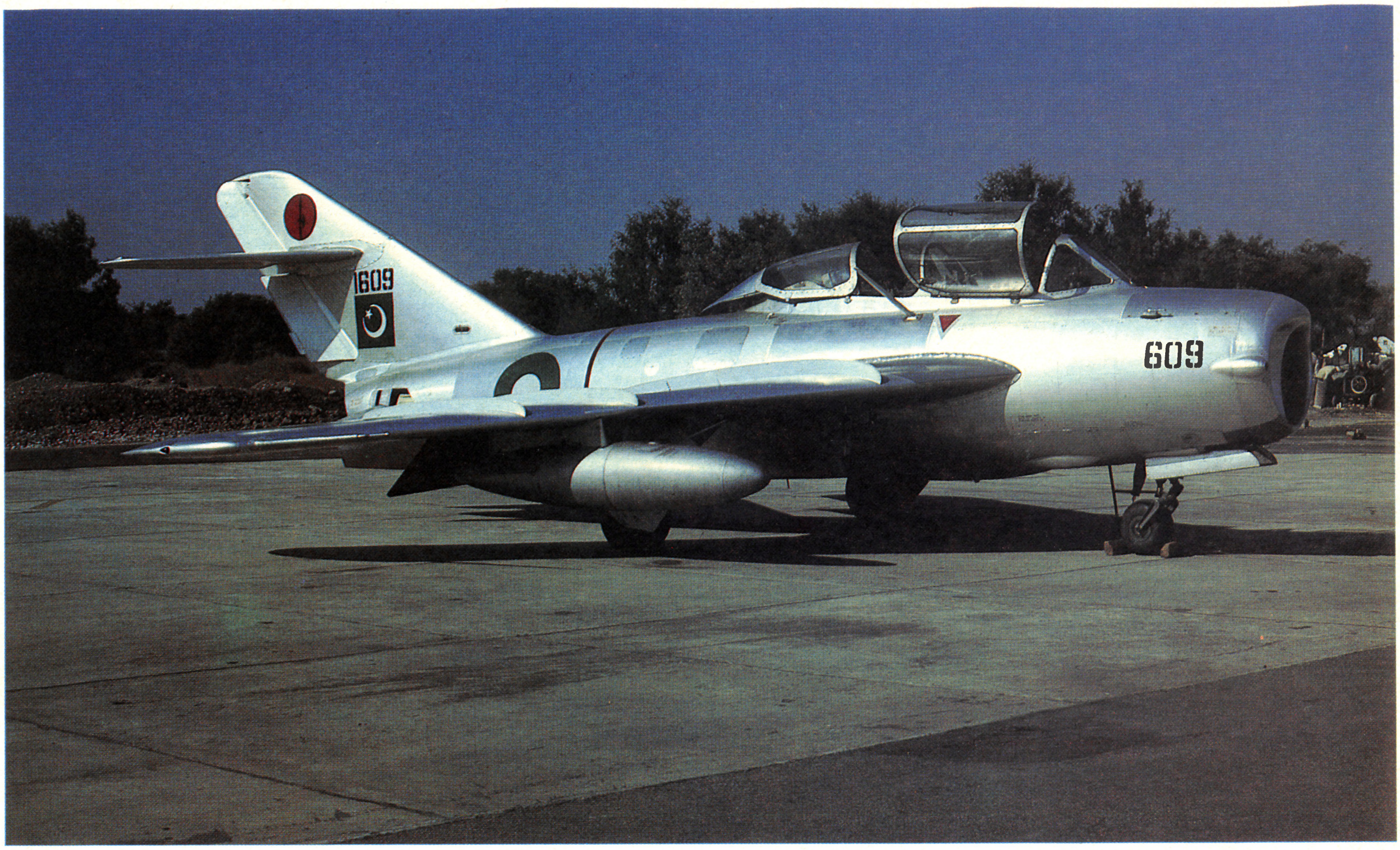
F-6 transitions in Pakistan were formerly undertaken via the MiG-15UTI, with first solos monitored from an accompanying chase aircraft. With receipt of its first FT-6s in September last year, however, the PAF was able to modify its training syllabus and equip two or three Operational Conversion Units with two-seat as well as single-seat versions of this Soviet-designed, Chinese-built fighter. Transitioning pilots now complete 20 dual landings in the FT-6 before going solo, plus about 66 sorties in the F-6 to complete the OCU course.

Although the rear cockpit of the FT-6 is raised only very slightly above the front, its forward view is considerably better than that from the FT-5. In addition to the sideways-hinged canopies, the rear cockpit has its own built-in windscreen for protection in an emergency escape, via two semi-automatic ejection-seats with face-blind actuation and relatively limited capabilities. The PAF's combat force of F-6s is currently being equipped with Martin-Baker PKD Mk 10 rocket-boosted ejection-seats capable of safe use down to zero speeds and heights, and the British company is also looking into the possibility of replacing the semi-automatic Chinese seats in the FT-6. In view of the relatively small numbers of aircraft involved, however, this may prove prohibitively expensive on a unit cost basis.

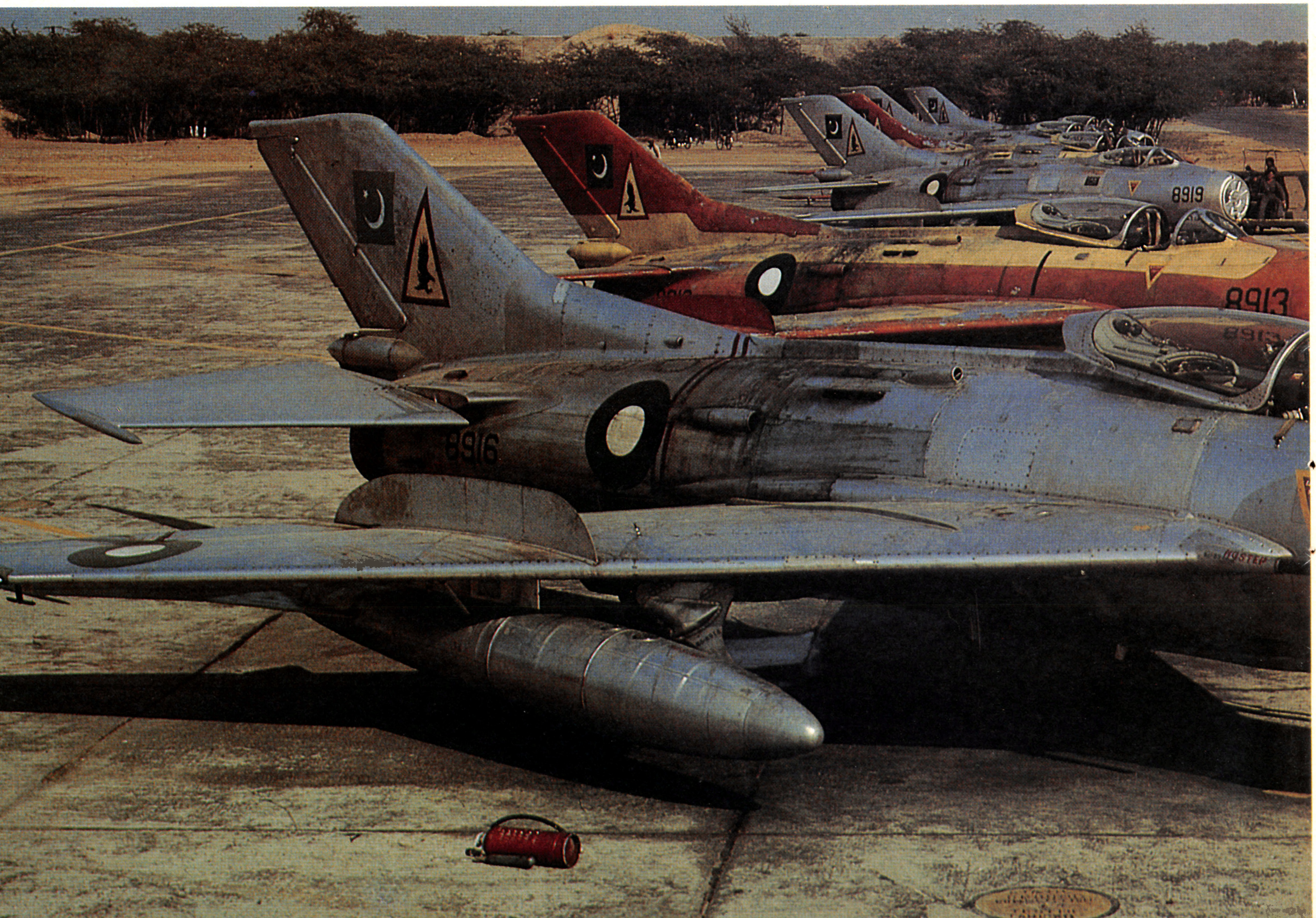
Compared with earlier F-6s, the new FT-6s recently received from Shenyang by Pakistan and Egypt, probably among several other countries, include a number of improvements and demonstrate a high standard of workmanship. Improved ground handling and deceleration are achieved by disc brakes and tubeless tyres, although the FT-6 retains the now-dated system of hand-operated pneumatic actuation for its braking system, including the MiG-19's unique braked nosewheel.

Another improvement in the FT-6 derived from later versions of the F-6 is the transfer of the tail-braking parachute from beneath the twin jet-pipes to a large acorn fairing below the rudder. This appreciably alters the distinctive contours of the MiG-19's former pen-nib aft-fuselage fairings and allows deployment of the tail parachute while the nosewheel is still off the ground, and from an approach speed of around 189 knots (350 km/h), as we found at Mianwali, its early deployment and retardation is most welcome.

Production of the F-6 and FT-6 is reportedly continuing at Shenyang and Tientsin at the combined rate of about 60 aircraft per month, and while most of these will go to the Air Force of the People's Liberation Army, further deliveries of both types, together with the FT-5, may be expected to other third-world countries. ☐



(Above) An FT-5 of the Fighter Conversion Unit at Mianwali. The fairing on the nose covers the intake for gun-sight radar ranging. (Below) Late-model F-6 single-seaters of No 25 Squadron (OCU) at Sargodha.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PAKISTAN AIR FORCE
A

(Above) One of the dozen or so Lockheed Hercules currently in service with the PAF, operated primarily by No 6 Squadron at Chaklala on re-supply flights in the north of Pakistan.

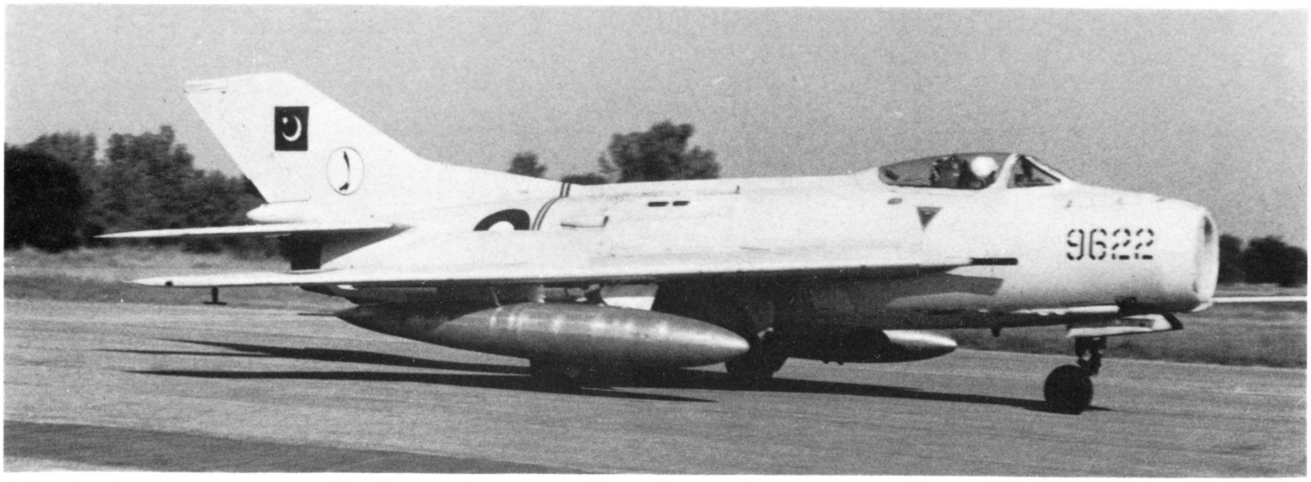
PAF now has no effective long-range daylight strike element. Furthermore, its single squadron of ageing Martin B-57 light bombers has severe operational limitations at night or in bad weather conditions.

Following the retirement last year of the last of its Canadair Sabre fighter-bombers through fatigue problems, and the 1976 veto by the Carter administration on the supply of 110 Vought A-7 Corsairs, on the basis of Pakistan's purchase from France of a nuclear reprocessing plant, the PAF therefore has an urgent requirement for a low-level long-range strike fighter. At the moment, no immediate procurement seems to be in prospect, but there is a school of thought in the PAF which favours the purchase of a lower-cost and less sophisticated type with dual close-support capabilities, such as the Hawk or Alpha Jet, rather than something like *Fantan*.

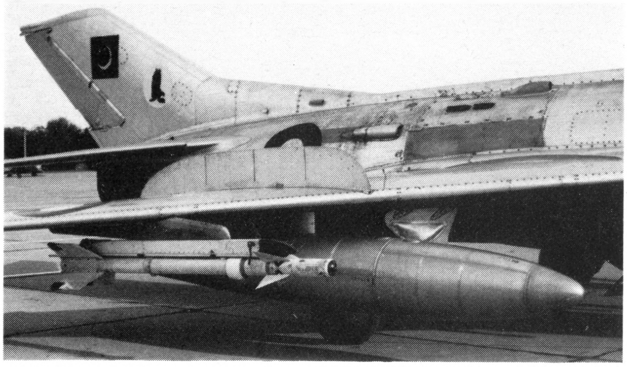
To maintain its national policy of non-alignment, Pakistan has spread its military purchases in recent years among such countries as China, France and even the Soviet Union, in place of earlier MAP supplies, but future procurement is likely to depend to a large extent on available credit. This problem is compounded by Pakistan's shortage of hard-currency foreign exchange, which will continue to favour procurement from the East rather than West.

From Air HQ at Peshawar, in the North-West Frontier Province and close to the Khyber Pass and Afghan border, the PAF is directed by the CAS and Vice Chief of Air Staff through three Deputy CAS controlling Operations, Administration and Maintenance Branches in the classic three-prong system. At the present time, the PAF operates fewer than 250 or so combat aircraft in 13 or 14 squadrons, optimised for air defence and air superiority missions, and manned by about 30,000 personnel, including approximately 3,000 officers, plus about 20,000 civilians. These also serve in transport, training and ancillary units completing the overall establishment.

Principal operational element in the PAF is now Air Defence Command, formed in 1975, with HQ at Chaklala,



(Above) A late-model Shenyang F-6 of No 14 Squadron (OCU) at Mianwali, showing the revised tail parachute stowage below the rudder, and Martin-Baker ejection-seat. (Below left) An AIM-9B Sidewinder mounted by the PAF on wing racks of an F-6 for the interception rôles.

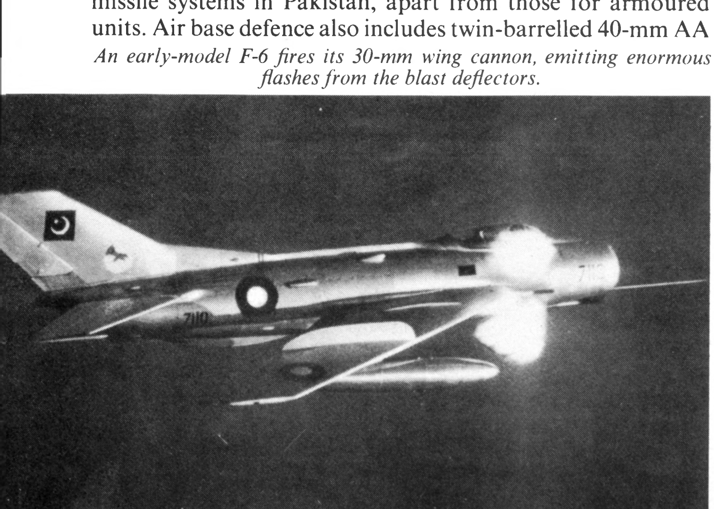


Rawalpindi, and currently commanded by Air Cdr K Anwar Murza. ADC is responsible for a year-round 24-hour surveillance of national airspace and its boundaries, and the co-ordination of all air defence elements and activities. Its control is exercised geographically on a regional basis through Sector HQ in the north, centre, south and west for the complete integration of early warning, interceptor missile and AA gun components, and extends over some 40 different units.

Pakistan's early warning and control system was modernised prior to the 1971 war with India by the acquisition of Plessey AR-1 low-level radars and Marconi Condor GCI stations, plus the installation of additional sites to the originals at Sakesar and Badin. These are supplemented by mobile observer units and are now linked with four PAF surface-to-air missile squadrons, each with two flights, equipped with Thomson-CSF/MATRA Crotale low-level all-weather SAMs ordered in 1975 for air base defence.

In PAF service, Crotale has proved somewhat complicated to operate, but with very rapid reaction times. The PAF has been given responsibility for the operation of all defensive missile systems in Pakistan, apart from those for armoured units. Air base defence also includes twin-barrelled 40-mm AA guns supplied from China, but the main ADC defensive strength comprises eight or nine squadrons of F-6 day interceptors of similar Chinese origin.

An early-model F-6 fires its 30-mm wing cannon, emitting enormous flashes from the blast deflectors.



Following the suspension of US military aid to both Pakistan and India after their 1965 war, Pakistan was forced to diversify its procurement and the Islamabad government gratefully accepted the provision by China of 75 F-6s, in several batches, for the air superiority rôles. According to the CAS, the Mach 1·4 F-6 has proved the "saving grace" of the PAF since the first arrived in 1966 to re-equip Nos 11, 23 and 25 squadrons. Modified in Pakistan to carry US AIM-9B/J Sidewinder AAMs on two underwing racks, in addition to the standard fixed-gun armament of three 30-mm heavy cannon, the F-6 has evolved as an extremely agile and effective day interceptor and air superiority fighter, although its fuel limitations restrict its capabilities for ground attack and close support.

In the opinion of the PAF, the F-6 is probably the cheapest combat aircraft to operate of any in its class, and costs about one-sixth as much as the Mirage III or 5 per flying hour. Both types have about the same manpower requirements, at around 50-60 maintenance man-hours per flying hour, but spares for the F-6 from China are very considerably cheaper. The F-6 has suffered from the limitations of very short component lives — engine TBO, for example, is only 100 flying hours, and 600 hours for the airframe — but this has been rectified by the donation by China of a complete Rebuild Factory in the new Pakistan Aeronautical Complex at Kamra, near Attock, so that the aircraft no longer have to be returned to the PRC for overhaul.

The F-6 Rebuild Factory was formally opened as recently as November, but accepted its first two aircraft immediately afterwards, and is scheduled to complete the overhaul of up to 30 of these fighters per year when operating at full capacity. Overhauls of the F-6's RD-9B turbojets have been undertaken for some time by the PAF at its Maintenance Unit at Sharea Faisal (formerly Drigh Road), just outside Karachi.

A further 60 F-6s were subsequently received by the PAF, plus others to form another five or six squadrons to operate within Air Defence Command from such bases as Sargodha, Peshawar, Rafiqui, Samungli and Masroor. In addition to the provision of Sidewinders, to supplement up to 32 57-mm Chinese-supplied rockets in underwing pods, the PAF F-6s are being modernised by the installation of Martin-Baker ejection seats, but more ambitious plans to fit new Western powerplants such as the Rolls-Royce Adour are unlikely to be put into effect because of funding problems.

In addition to its nine or so squadrons of F-6 day interceptors, ADC can call upon one of the PAF's four Mirage

continued on page 201

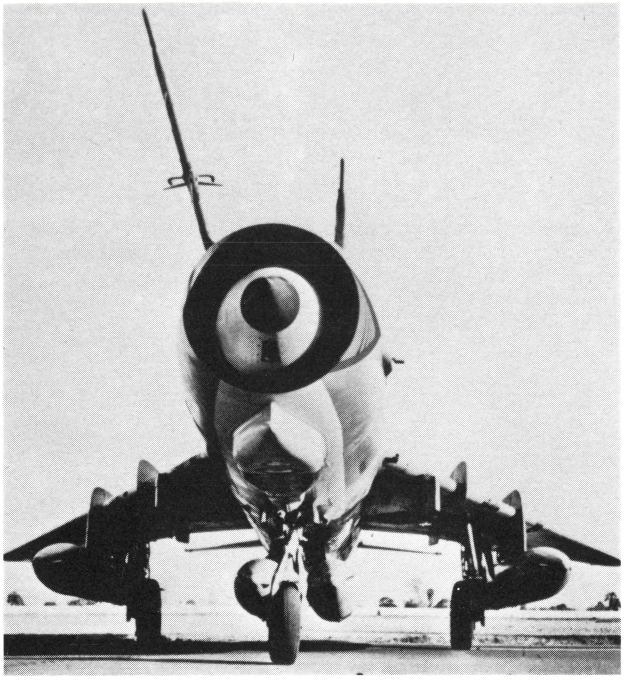
SURVIVAL OF THE FITTER

THE 25-YEAR SAGA OF A SUKHOI TACTICAL FIGHTER FAMILY

A QUARTER-CENTURY AGO, in 1955, test pilot Kochetov made the first flight test with the S-1, the prototype of a large single-seat tactical fighter powered by a massive Lyulka turbojet. Insofar as the Soviet aircraft industry was concerned, the S-1 embodied several innovations, not least of which were its movable intake shock cone and slab-type all-flying tailplane. Nevertheless, neither Kochetov nor pilots Mikhailin and Korovushkin, with whom he was to share the subsequent flight development programme, could have anticipated that this prototype would provide the basis of a warplane that would still be the subject of development in the 'eighties! Yet, the next 25 years were to witness what must surely be the most extraordinary example of incremental development in the annals of combat aircraft design.

The S-1, created by the newly-resuscitated design bureau of the late Pavel O Sukhoi and to demonstrate M = 2·05 early in its test programme, was the first dedicated interdiction and close air support fighter developed in the Soviet Union since WWII. While a small pre-series was being built for service evaluation by the V-VS TacAir component, the *Frontovaya Aviatsiya* (FA), as the Su-7, a second prototype embodying some aerodynamic refinement, the S-2, joined flight test, and it was this, in productionised S-22 (or S-2-2) form, that was to be ordered into large-scale production in 1958 as the Su-7B.

The début of the Su-7B in the FA armoury in 1959 was acknowledged in the West by the addition of *Fitter* to the list of ASCC-assigned reporting names for Soviet aircraft. Twenty years later, in 1979, the number of suffix letters appended to that reporting name was *still* growing! The *Fitter-H* joining the ranks of the FA in that year represented immense capability enhancement over its progenitor, the *Fitter-A* of the late 'fifties. Admittedly, what little physical resemblance that remained between the first of the genus and its semi-variable-geometry derivatives, such as *Fitter-C* that had entered service a dozen years later, had finally dissipated. A shared reporting name or no, *Fitter-H* retained *none* of the commonality with the original *Fitter* that had presumably provided some justification for the retention of the ASCC appellation.

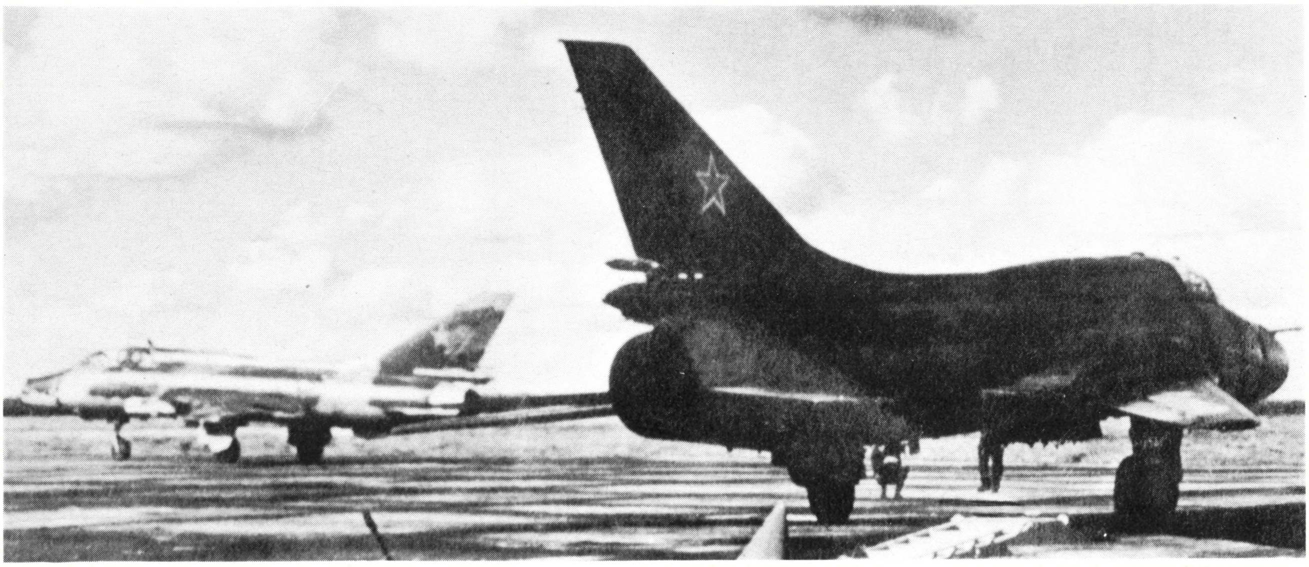


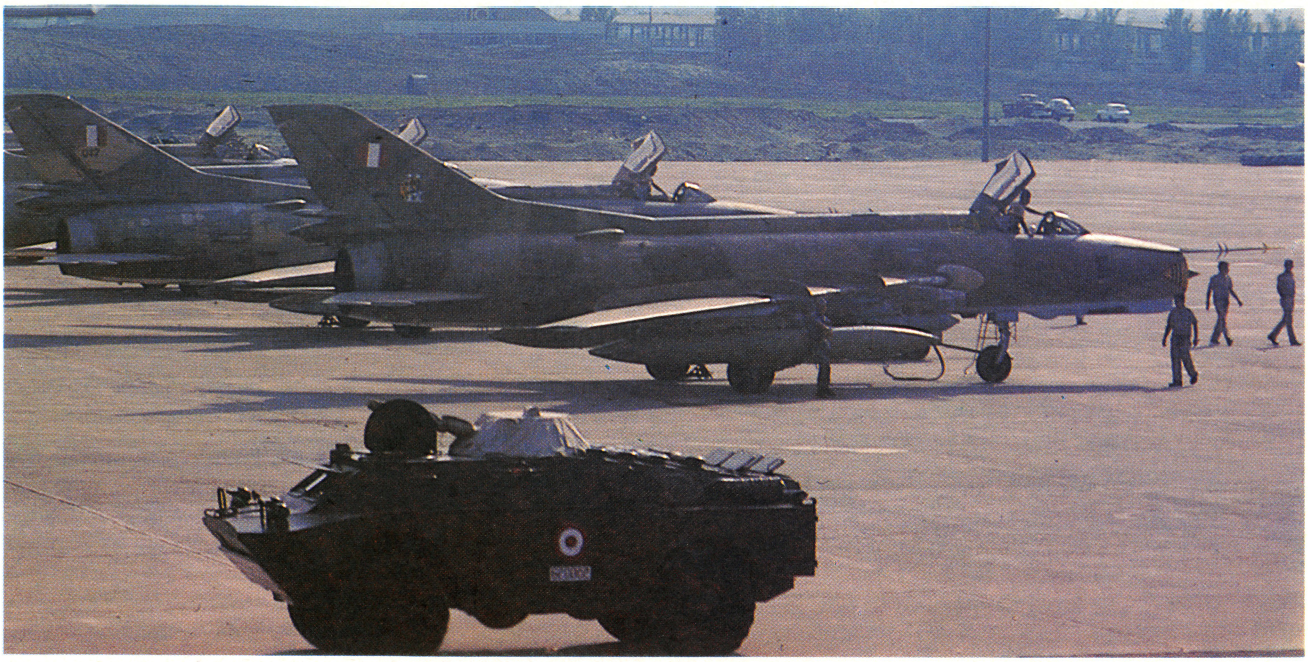
However, if *Fitter-A* and *Fitter-H*, separated by a score of years in service introduction, were so disparate as to constitute totally different designs, they served to demonstrate that the traditional Soviet disinclination to relinquish a sound basic design until it had been exploited to the ultimate remained unchanged. They also demonstrated the remarkable effectiveness of the Sukhoi bureau's incremental design policy.

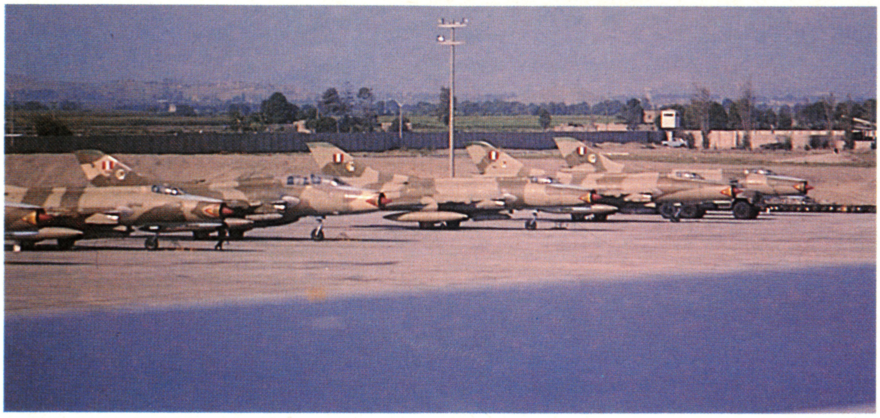
Prolonged progression

During some 16 years of continuous production, the fixed-geometry *Fitter-A* had been the subject of constant development, resulting in the Su-7BM, Su-7BKL and Su-7BMK, and the parallel two-seat transitional training Su-7U, Su-7UM and

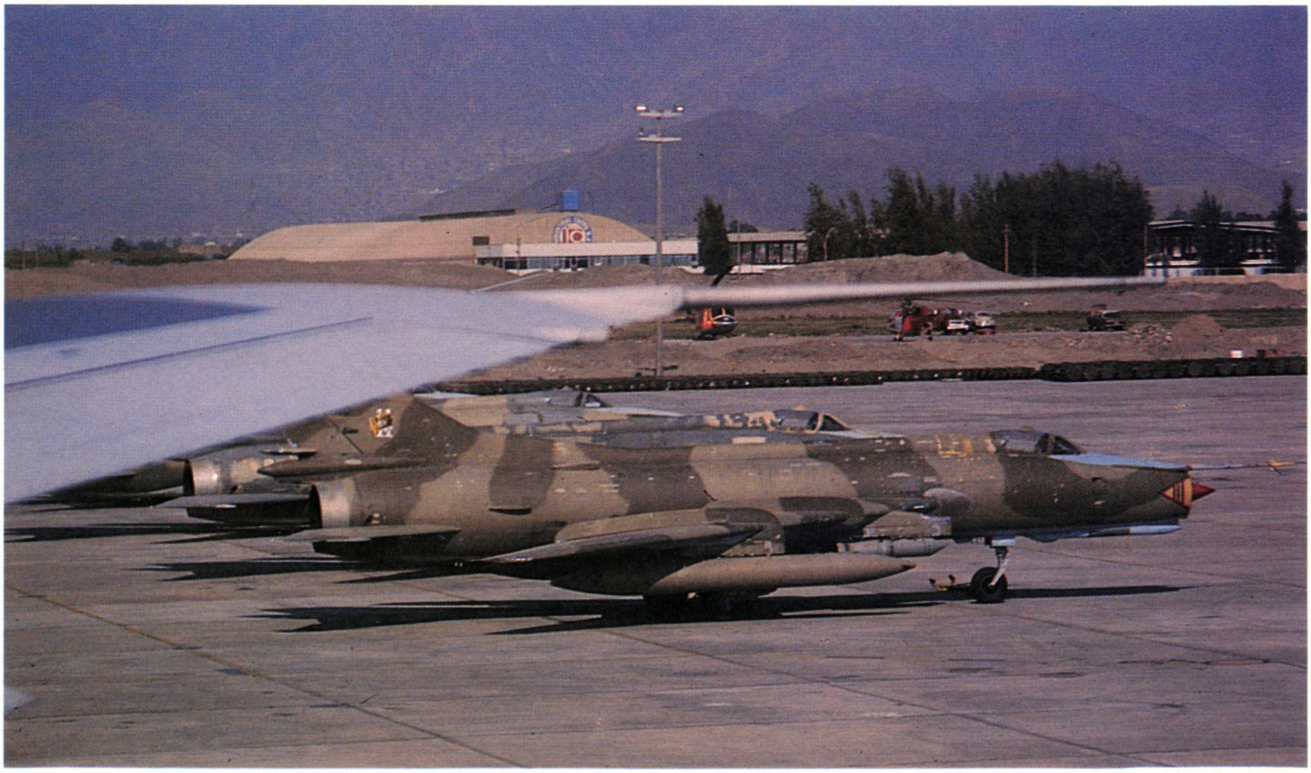
(Head of page) Fitter-F, an export derivative of Fitter-D. The laser marked target seeker can be seen in the intake centre body and the elongated-lozenge-shaped avionics housing can be seen beneath the nose. (Below) Fitter-H (foreground) and its equivalent two-seater, Fitter-G, show the revised forward fuselage, enlarged fuel-housing dorsal fairing and enlarged vertical tail surfaces.

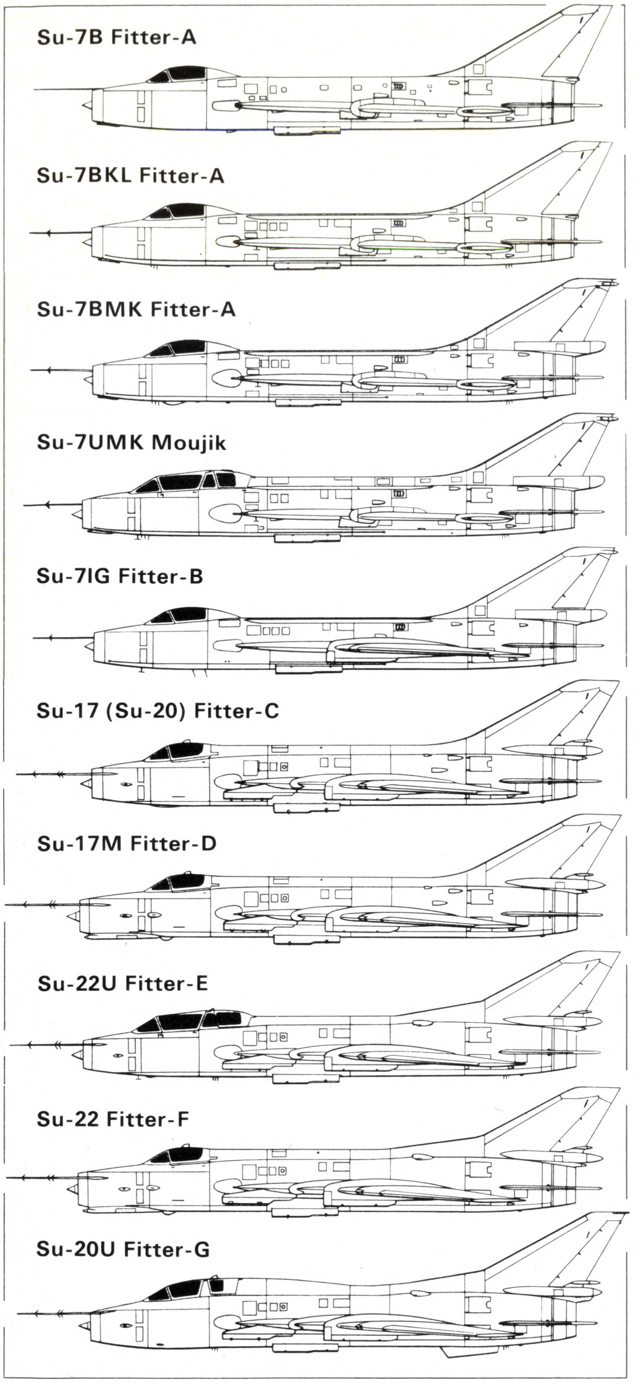






On this page we publish the first photographs to illustrate the Sukhoi Su-22 Fitter-F in service with the Fuerza Aérea Peruana, a two-seat Su-22U Fitter-E also being visible in the line-up left. The first Su-22s were purchased by Peru in 1976, and those illustrated on this page belong to Escuadron de Caza 11 "Los Tigres" of Grupo de Caza 12. Normally based at Las Palmas, this Escuadron is seen at the Jorge Chavez Airport, Lima, to where it has been deployed during the current tension between Peru and Ecuador. A second unit operating the Su-22 within the FAP is the Escuadron de Caza 13. The original purchase of the Sukhoi aircraft by the FAP comprised 32 single-seat Su-22s and four two-seat Su-22Us, but a further batch of 16 was ordered last year.





Su-7UMK, but changes were detail rather than fundamental until, in 1966, the S-22I, alias Su-7IG*, was flown. Publicly demonstrated at Domodedovo in July of the following year and assigned the ASCC reporting designation *Fitter-B,* this was a technology demonstrator adaptation of the Su-7B *Fitter-A* and the first Soviet exercise in variable wing sweep. Essentially a low risk, low cost means of gaining variable-geometry experience, the S-22I *Fitter-B* may be assumed to have proved the efficacy of half-span wing pivot points and to have demonstrated the very real gains offered by the movable outer panels, for, in 1971, a production derivative, the Su-17 *Fitter-C,* began to reach the FA.

Whereas the *Fitter-B* had been a straightforward adaptation of the *Fitter-A* airframe, the *Fitter-C* took the process of incremental design development a stage further. The wing remained basically similar to that of the v-g prototype but was now mated with a derivative engine of the original AL-7F series turbojets. This, the similarly-dimensioned AL-21F, offered a respectable increase in power and a modest improvement in SFC. A nominal increase in internal fuel capacity was acquired by adopting the deeper fuel-housing dorsal spine that had been introduced by the two-seat Su-7U as a means of compensating for some of the ill-afforded loss in tankage that had inevitably accompanied the introduction of a second seat in a dimensionally barely lengthened (by 12 in/30 cm) fuselage.

The result was a tactical fighter capable of lifting from much shorter airstrips almost double the ordnance load and carrying it some 25-30 per cent further. A multi-rôle warplane toting respectable payloads over reasonable radii. This was more than could be claimed for the preceding fixed-geometry *Fitter-A,* the good low-level gust resistance and manoeuvrability, and highly-regarded handling qualities of which the *Fitter-C* reputedly retained. Within little more than two years of its FA début, *Fitter-C* was being exported to WarPac countries and Middle Eastern recipients of Soviet military aid.

The export version of *Fitter-C* was referred to by its recipients as the Su-20, and there is some evidence to suggest that this designation is also used by the V-VS. This possibly reflects a change in the long-standing Soviet practice of assigning sequential *odd* numbers to successive "fighter category" aircraft from each design bureau, with *even* numbers now being assigned to such aircraft with the primary missions of support *(podderzhka)* and air escort *(soprovozhdeniye)** — the Soviet Union does not usually employ the western terms "interdiction" and "close air support" — irrespective of any secondary air-air capability. The equipment standards of export *Fitter-C*s have apparently varied, presumably to meet the "Soviet-recommended" requirements of the recipient air arm.

Late in 1976, a further stage in the evolution of *Fitter* was reached when a version with a higher-standard avionics fit and increased compatibility with the newer generation of tactical air-ground weapons that had by now begun to enter the FA armoury attained operational status. This, *Fitter-D,* was the first model to be equipped with terrain-avoidance radar and a laser marked target seeker. The laser ranger was accommodated within the lower half of the intake centrebody and the fuselage nose was lengthened 1·25 ft (38 cm) to permit a flat, elongated-lozenge-shaped avionics housing to be mounted beneath the nose, ahead of the nosewheel bay, the aft end of this housing apparently accommodating doppler. Oddly, no attempt would seem to have been made on *Fitter-D* to compensate for the inevitable destabilising effect resulting from this longer and deeper forebody. However, when, during the course of 1977, a similarly-equipped export model, the Su-22 *Fitter-F,* began to appear in combat aircraft shipments to certain Middle Eastern air forces, and was also supplied to the Peruvian Air Force to meet an order placed in the previous year, a deeper dorsal fin had been introduced to augment directional stability.

A design change introduced with *Fitter-F* and to be retained by succeeding variants of the Sukhoi ground attack fighter was an increase in the diameter of the rear fuselage, this increase being vertically asymmetric. As there was no evidence to suggest a change of engine, the greater diameter aft was most likely effected for aerodynamic reasons, although a more imaginative and just conceivable reason could have been the introduction of semi-wrap-around fuel tankage. However, although an aerodynamically efficient means of increasing internal fuel capacity and a possible means of compensating

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**IG = Izmenyaemaya Geometriya (variable geometry), the term Izmenyaemaya Strelovidnost' (variable wing sweep) being more frequently used.*

**Aviation* support *is taken to mean the delivery of air-ground ordnance in the vicinity of the frontline, while aviation* escort *translates as delivery of air-ground ordnance in support of friendly forces operating beyond breached enemy defences.*

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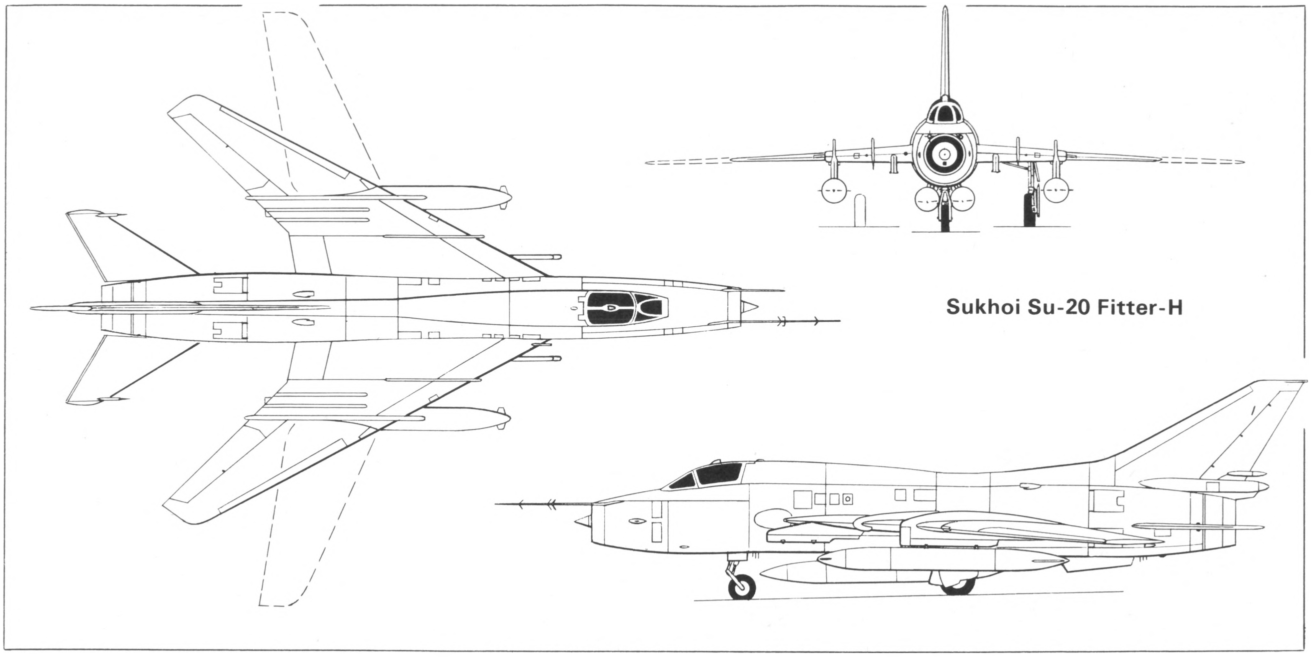
Sukhoi Su-20 Fitter-H

for the minor forward shift in the CG that would have accompanied the lengthening of the forward fuselage and the installation of additional equipment under the nose, the modest increase in capacity in which such would result would scarcely seem to warrant the added complexity. A reduction in the number of auxiliary air intakes produced some cleaning up.

A parallel development was the tandem two-seat *Fitter-E* transitional trainer with limited secondary operational capability. While using the basic *Fitter-C* airframe, the two-seater grafted on a forward fuselage essentially similar to that of the fixed-geometry Su-7U *Moujik*.

Into the 'eighties

Mid-1979 saw two further developments in the *Fitter* series reach FA regiments, *Fitter-G* and *-H*, and with these the last vestiges of similarity to the *Fitter-A* of the late 'fifties finally disappeared. Respectively two-seat and single-seat variants, these mated a new forward fuselage with the larger diameter aft fuselage of *Fitter-F*, and coupled the deeper dorsal fin with appreciably taller vertical tail surfaces and a comparatively small ventral fin. The new forward fuselage was both deepened and drooped slightly, affording improved vision from the rear seat of the two-seater, the decking behind the rear aft-hinging canopy being both raised and broadened to produce optimum aerodynamic form and maximum fuel tankage. The centrebody laser seeker was retained but the fuselage nose reverted in length to that of *Fitter-C*, the undernose avionics pack of *Fitter-D* being discarded. Like *Fitter-E*, the two-seat *Fitter-G* discards the portside wingroot 30-mm cannon, but in other respects appears to retain full weapons capability, and *Fitter-H* has an identical airframe apart from the discarding of the second cockpit and the restoration of the fuel tankage space that this occupied. While improving view from the rear cockpit of *Fitter-G*, the drooped nose undoubtedly also offers *Fitter-H* superior ground target acquisition, and the loss in directional stability in which its greater side area results has certainly been compensated for by the very much taller vertical surfaces and the ventral fin, the added vertical area also presumably being useful when large stores are carried.

The performance of *Fitter-H* can be assumed to be much the same as that of *Fitter-C*, tactical radius being increased by

continued on page 205

(Right) A pilot climbing into the cockpit of a Fitter-H. The nose droop is not obvious in this photograph, but the repositioned pitot, and the deeper and broader fairing aft of the cockpit can be seen. (Left) A line-up of Fitter-Ds, the first version of the Sukhoi tactical fighter to be equipped with terrain-avoidance radar and a laser marked target seeker. The Fitter-D is essentially similar to the export Fitter-F illustrated in Peruvian service on page 170.

UNCLE SAM'S GALLIC GUARDIAN

ON THE morning of 17 December 1903, the Life Saving Station at Kill Devil Hills was unusually busy. Not only were four members of the US Life Saving Service itself present — more than the routine activities of the Station required — but they also had a young visitor from one of the nearby communities. The day was fair but a blustery wind was gusting across the sand dunes, and it was with some surprise that the occupants of the Life Saving Station saw, at about 10 o'clock in the morning, a red flag appear over the large shed, a mile distant, where two brothers from Dayton, Ohio, were experimenting with flying machines.

The flag was a pre-arranged signal to show that the would-be aviators were planning further attempts to fly in their strange machine; anyone who saw the signal was welcome to join the party at the camp and to lend a hand in moving the "airplane" to its launching point. The men of the Life Saving Station had on several previous occasions trekked across the dunes for this same purpose and on this historic morning all four, together with their visitor, were soon at the Wright brothers' camp. Thus it was that on the occasion of the very first powered, sustained and controlled flight on record, made later on that day by Wilbur Wright, the US Life Saving Service was involved; some 12 years later, that Service was absorbed into the US Coast Guard, and aviation has figured prominently in its activities ever since.

Today, the Coast Guard missions have expanded, although the primary rôle is unchanged — to find the lost, to help the injured and to save the imperilled. To that mission has been added such latter-day requirements as pollution surveillance, law enforcement patrolling of US territorial waters and the protection of the 200-mls (322-km) Fishery Conservation Zone around the shores of mainland USA. In the fulfillment of these rôles, the Coast Guard uses a variety of aircraft, both fixed-wing and helicopters, and it is in the former category that an important new "workhorse" is now on the point of entering service, in the shape of the Dassault-Breguet HU-25A Guardian. This specially-developed version of the Falcon 20* was adopted by the Coast Guard in January 1977 after an intensive competition to find a Medium Range Surveillance (MRS) aircraft to replace the widely-used Grumman HU-16E Albatross medium-range search-and-rescue amphibians and the Convair HC-131As put into service a few years ago as interim medium-range SAR and law-enforcement aircraft. The order for 41 of the Dassault-Breguet Guardians marked the first purchase of non-American aircraft by the US Coast Guard in its 65-year history — an event that did not go uncontested by the indigenous aircraft manufacturers!

The decision to allow the Coast Guard to purchase the Falcon 20, announced on 5 January 1977 by the then Secretary of Transportation William T Coleman, Jr, came, in fact, some

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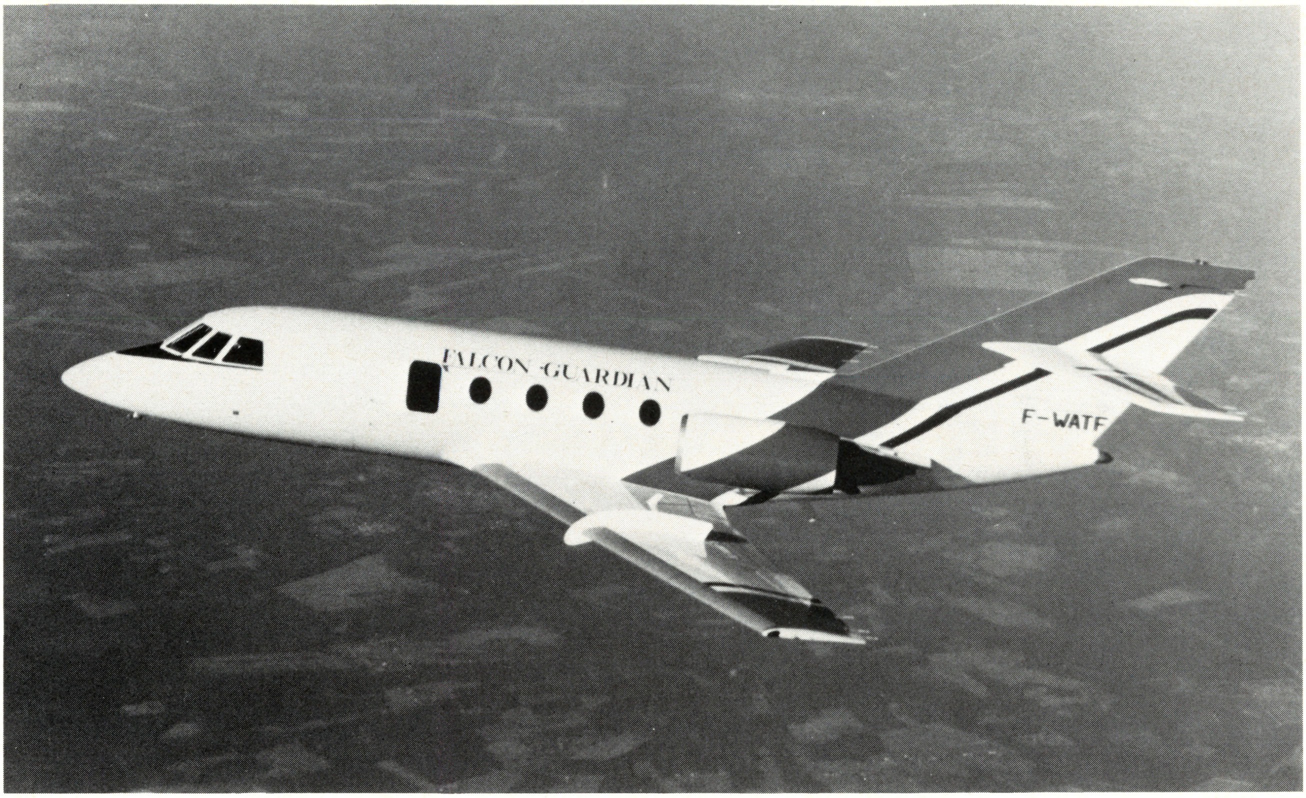
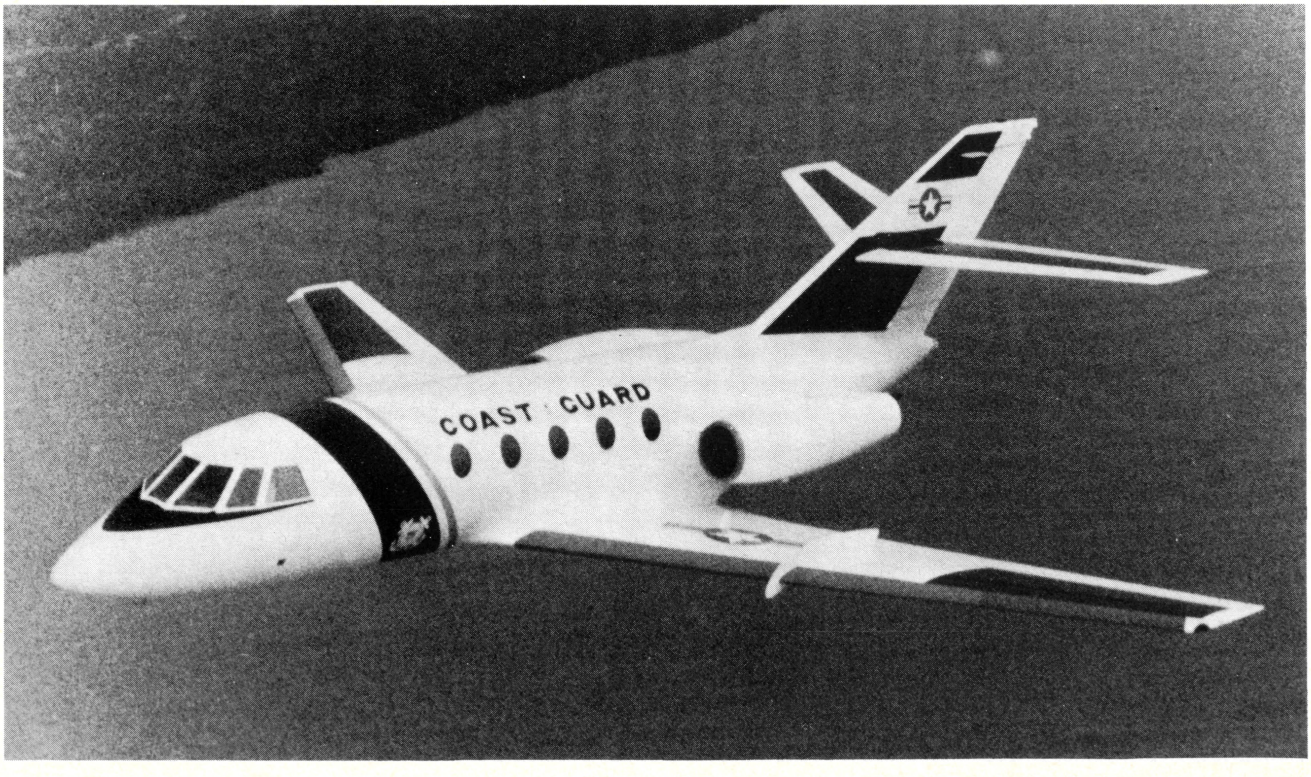
**The name Falcon was adopted early in 1966 (initially, Fan Jet Falcon) for those examples of the Dassault Mystère 20 sold in the Western Hemisphere through the Business Jet Sales Division of Pan American, which was set up in 1963 for the specific purpose of distributing the French biz-jet. Subsequently, the names Mystère and Falcon have become largely interchangeable, with the latter widely used in non-French-speaking areas; and in 1972 Falcon Jet Corporation was set up as a jointly-owned (Dassault-Breguet/Pan Am) company to continue the activities of the airline's Business Jet Sales Division. For consistency, Falcon is used throughout this article, although at some points contemporary references would have used the name Mystère.*

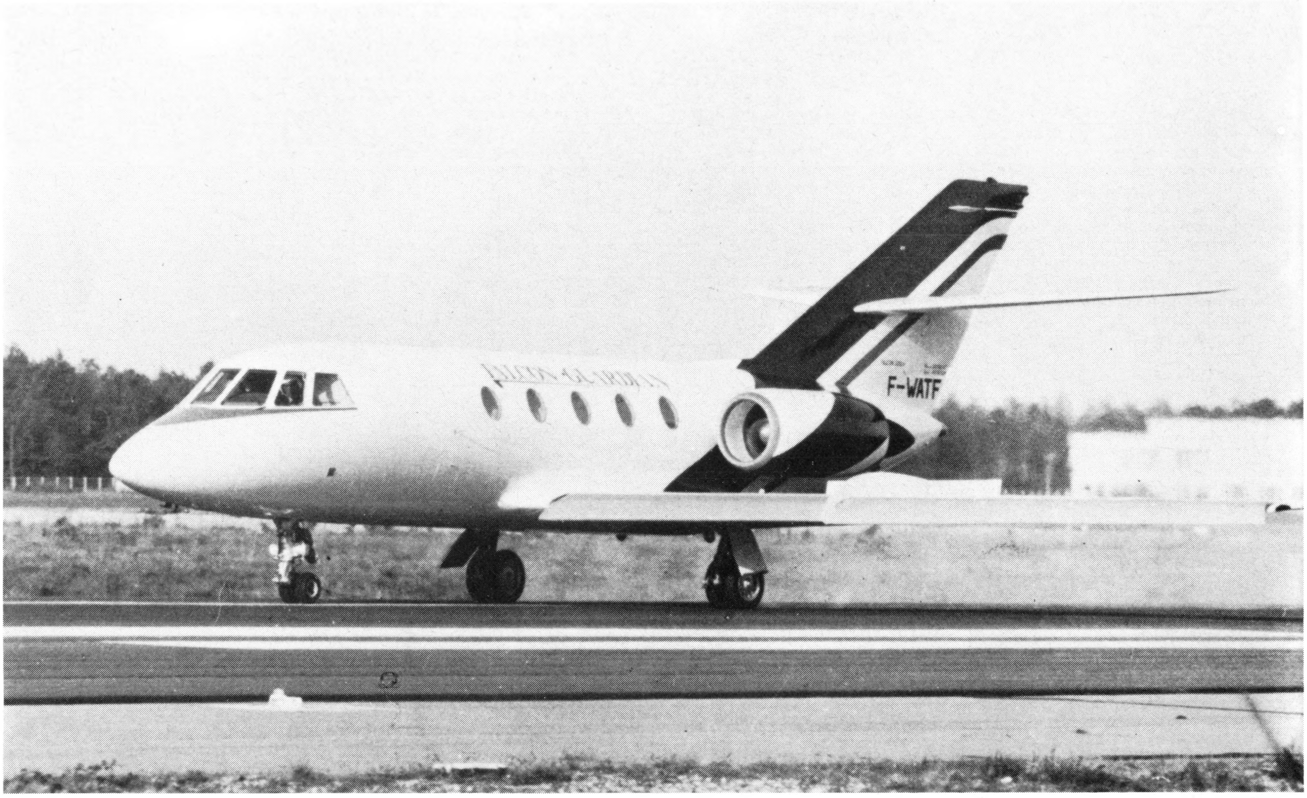


First flown on 28 November 1977, F-WATF is the prototype Falcon 20G, being a standard production Falcon 20F fitted with Garrett AiResearch ATF3 engines. It was later fitted with the enlarged observation window at the front of the cabin, as seen here.

six years after the MRS requirement had first been identified, and only after intensive activity by several major US companies, including Rockwell International, Lockheed and Gulfstream American. In the first instance, the Coast Guard had indicated that it would purchase the specially-developed Rockwell Sabreliner 75C (with Avco Lycoming ALF-502 engines), but this proposal drew vigorous criticism on the grounds that the contract had not been the subject of open competition. Responding to Congressional pressure, the Coast Guard therefore opened an MRS competition in 1975, having by this time established that its requirements could be met only by a turbofan-powered aircraft (for adequate high-speed dash performance and "over-the-weather" capability), and that a cabin volume of 600 cu ft (17,0 m^3) would be

Celebrating the success of the Falcon in winning the US Coast Guard contract at the beginning of 1979, the Falcon 20F No 361 was displayed in Coast Guard colours at the Paris Air Show later that year, before its sale to the Egyptian Air Force.

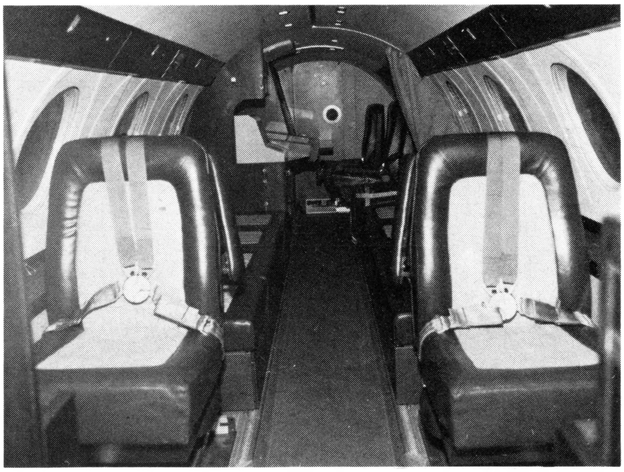




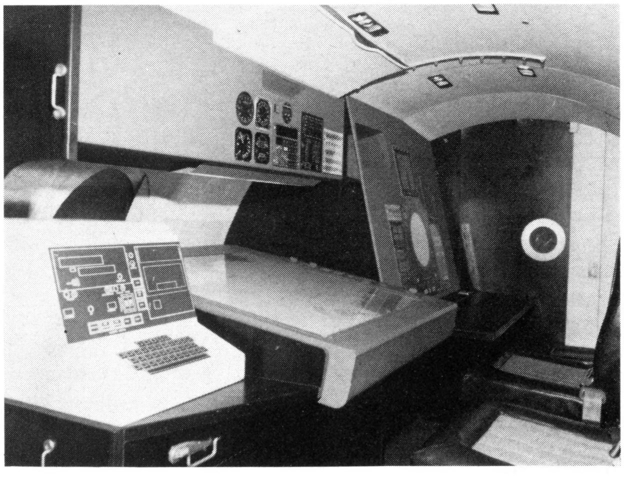
As first flown, the prototype Falcon 20G retained the standard commercial Falcon's cabin windows and, as seen here, the large wing fences that had been a feature of all earlier Falcon versions. Smaller fences are now applied to the Falcon 20G and 20H.

required to allow the aircraft to carry all the equipment necessary to perform the several MRS missions without returning to base for a change of equipment. The basic mission requirement was for a 700-naut ml (1 300-km) loiter at 2,000 ft (610 m) at a distance of 150 naut mls (278 km) from base; transfers to and from the search area were to be made at high altitude for best speed and economy. A high speed of at least 350 kts (650 km/h) was required, together with a search speed not greater than 220 kts (410 km/h) IAS at 2,000 ft (610 m).

The MRS competition drew an initial response in March 1976 from Rockwell with the Sabreliner 75C; from Gulfstream American with two versions of the Gulfstream 2, powered by Spey or General Electric CF-34 turbofans; from ICX Aviation with a variant of the Yak-40 powered by Garrett AiResearch TFE 731-2 turbofans; from Lockheed with a JetStar variant with two CF-34 engines, from VFW-Fokker with two versions of the VFW 614, powered by CF-34s and with either Bendix or Collins avionics; and from Falcon Jet Corporation (FJC) with a variant of the Falcon powered by Garrett AiResearch ATF3-6 turbofans and identified as the Falcon HX-XX. Of these various projects, only three were in the end made the subject of firm bids towards the end of 1976, these being from FJC, VFW-Fokker and Lockheed. The bids were opened on 28 October, and showed that, based on a 41-aircraft programme, the Falcon was cheapest, at $4,996,251 per aircraft. The VFW 614 price was 19 per cent higher and the JetStar was 26 per cent higher; however, under the terms of the Buy American Act, a 12 per cent addition would have to apply to the VFW 614 price for comparative purposes, since this aircraft would be regarded as a "foreign end product". The Falcon HX-XX, on the other hand, was regarded as a "domestic source end product", since FJC proposed to import bare airframes from France and to fit them virtually exclusively with US products at an assembly centre in the USA. Thus, 68·1 per cent of the unit cost of the Falcon could be regarded as American (well over the 50 per cent necessary to qualify as a domestic source end product); and if total operating costs over 10 years were taken into account, the proportion rose to 74 per cent

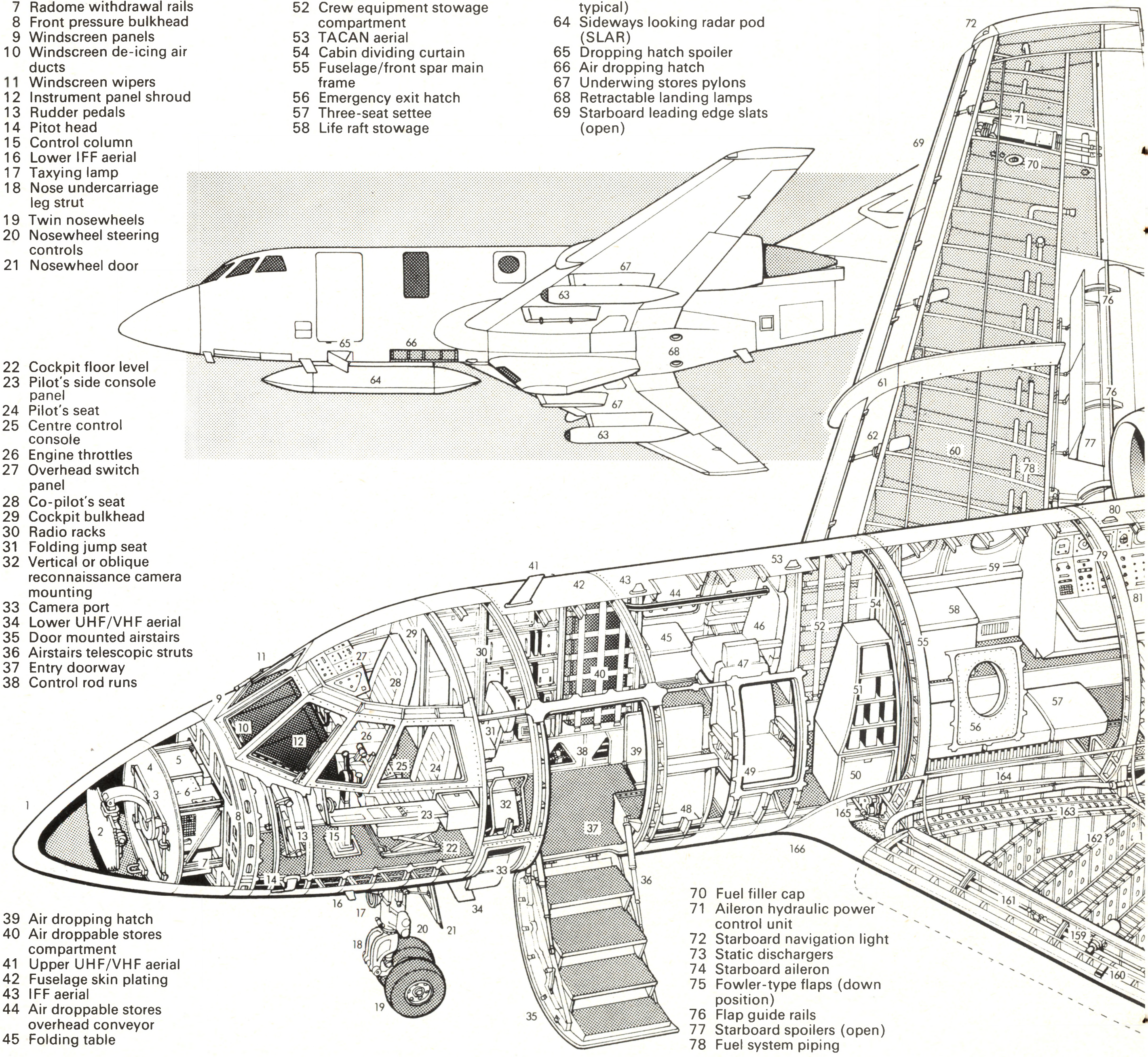


Interior views, above and below, show the surveillance system operator's position in the rear of the Guardian's cabin, with observer seats at the front of the cabin.



Dassault-Breguet HU-25A Guardian Cutaway Drawing Key

1 Radome
2 Planar radar scanner, Texas Instruments AN/APS-127 Sea Search radar
3 Radar tracking mechanism
4 Anechoic bulkhead
5 Radar synchronizer
6 Radar transmitter/receiver
7 Radome withdrawal rails
8 Front pressure bulkhead
9 Windscreen panels
10 Windscreen de-icing air ducts
11 Windscreen wipers
12 Instrument panel shroud
13 Rudder pedals
14 Pitot head
15 Control column
16 Lower IFF aerial
17 Taxying lamp
18 Nose undercarriage leg strut
19 Twin nosewheels
20 Nosewheel steering controls
21 Nosewheel door
22 Cockpit floor level
23 Pilot's side console panel
24 Pilot's seat
25 Centre control console
26 Engine throttles
27 Overhead switch panel
28 Co-pilot's seat
29 Cockpit bulkhead
30 Radio racks
31 Folding jump seat
32 Vertical or oblique reconnaissance camera mounting
33 Camera port
34 Lower UHF/VHF aerial
35 Door mounted airstairs
36 Airstairs telescopic struts
37 Entry doorway
38 Control rod runs
39 Air dropping hatch
40 Air droppable stores compartment
41 Upper UHF/VHF aerial
42 Fuselage skin plating
43 IFF aerial
44 Air droppable stores overhead conveyor
45 Folding table
46 Starboard observer's swivelling seat
47 Port observer's swivelling seat
48 Underfloor oxygen cylinder
49 Observation window
50 Drawer-type toilet unit
51 Galley/bar unit
52 Crew equipment stowage compartment
53 TACAN aerial
54 Cabin dividing curtain
55 Fuselage/front spar main frame
56 Emergency exit hatch
57 Three-seat settee
58 Life raft stowage
59 Cabin wall trim panels
60 Starboard wing integral fuel tankage; total fuel capacity 1,585 US gal (6 000 l)
61 Starboard wing fence
62 Leading edge slat jacks
63 Underwing sensor pods (infra-red or ultra violet typical)
64 Sideways looking radar pod (SLAR)
65 Dropping hatch spoiler
66 Air dropping hatch
67 Underwing stores pylons
68 Retractable landing lamps
69 Starboard leading edge slats (open)
70 Fuel filler cap
71 Aileron hydraulic power control unit
72 Starboard navigation light
73 Static dischargers
74 Starboard aileron
75 Fowler-type flaps (down position)
76 Flap guide rails
77 Starboard spoilers (open)
78 Fuel system piping
79 Fuselage/rear spar main frame
80 DME aerial
81 Surveillance system operator's instrument console



American and 26 per cent for the French contributions (made principally by Dassault-Breguet, Aérospatiale and Hispano-Messier). Having already been accepted by the Coast Guard as technically capable of fulfilling the MRS mission, the Falcon was thus the inevitable choice on grounds of lowest cost, and although apparently a "foreign" type was demonstrably more American than French.

The Guardian in detail

Designated, for Coast Guard service, the HU-25A and named the Guardian, the aircraft selected in January 1977 was a variant of the biz-jet launched by the Dassault company at the end of 1961. As the Mystère 20 and, later, Falcon 20, the biz-jet had entered production in 1963 and had sold steadily and successfully in several versions, powered by General Electric CF-700 turbofans. Dassault-Breguet* first indicated its intention to introduce a version of the Falcon with new turbofans in the 5,000 lb st (2 268 kgp) class during 1975, when the designation Falcon 20G was applied. At that time, a choice of engines was under study — either the 5,050 lb st (2 290 kgp) Garrett AiResearch ATF3-A-6 or the 5,400 lb st (2 450 kgp) Rolls-Royce RB.401. The former was a derivative of the YF104 that had been used in the Ryan *Compass Cope* RPV, while the RB.401 was a new project aimed specifically at the business jet market. In the course of 1976, Dassault-Breguet

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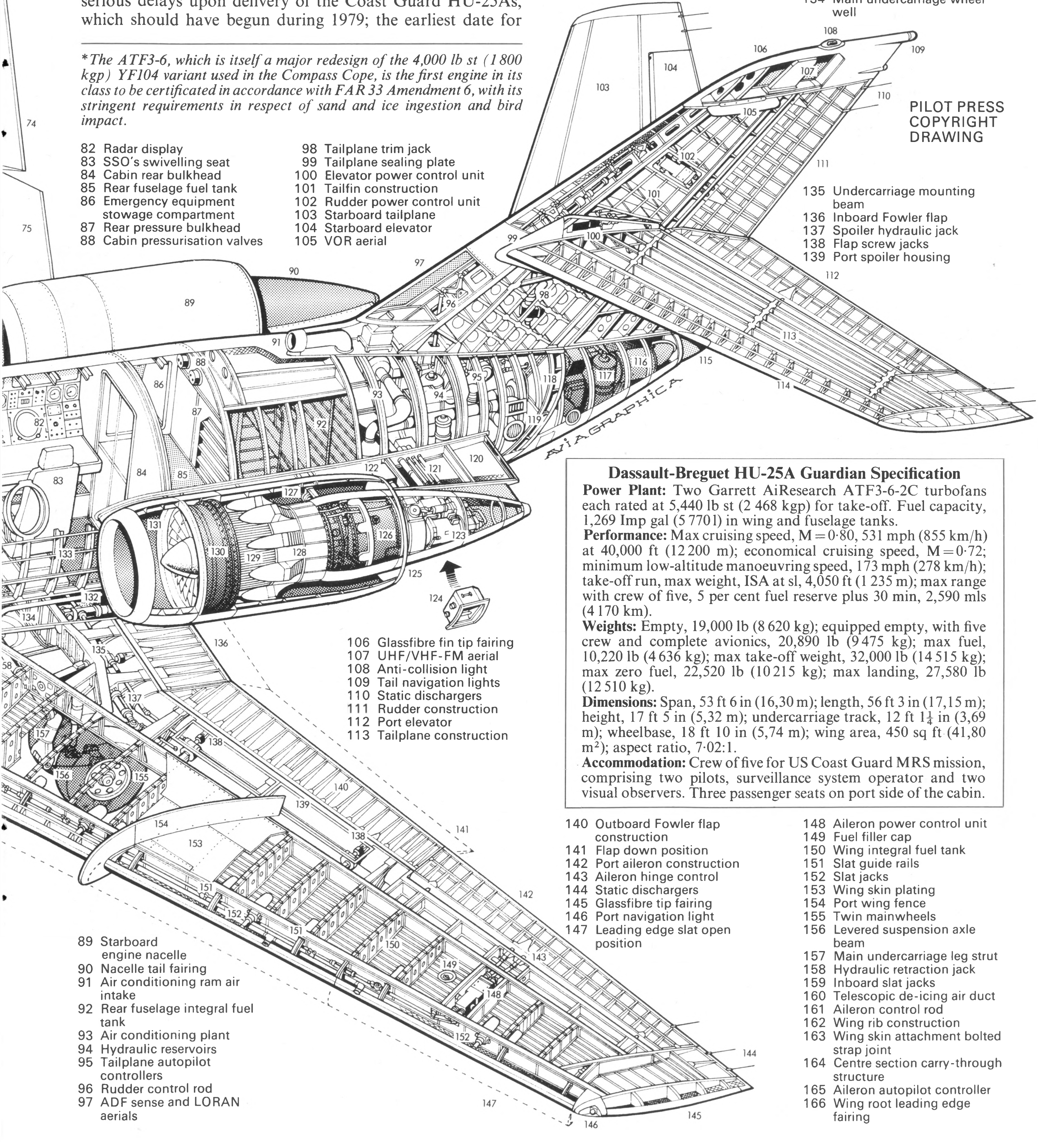
**Avions Marcel Dassault had merged with Breguet Aviation on 14 December 1971 to become Dassault-Breguet Aviation.*

narrowed its choice down to the American engine since no firm programme for RB.401 production was set up by Rolls-Royce, and the HX-XX submission to the Coast Guard was thus based on the projected Falcon 20G with the ATF3 engines, for which Garrett then expected to obtain civil certification by the beginning of 1978. This last expectation has not been fulfilled; a succession of development problems has delayed the ATF3 programme and up to February 1981 the company had been unable to complete the 150-hr endurance test required before the FAA would issue a certificate.* This in turn has imposed serious delays upon delivery of the Coast Guard HU-25As, which should have begun during 1979; the earliest date for

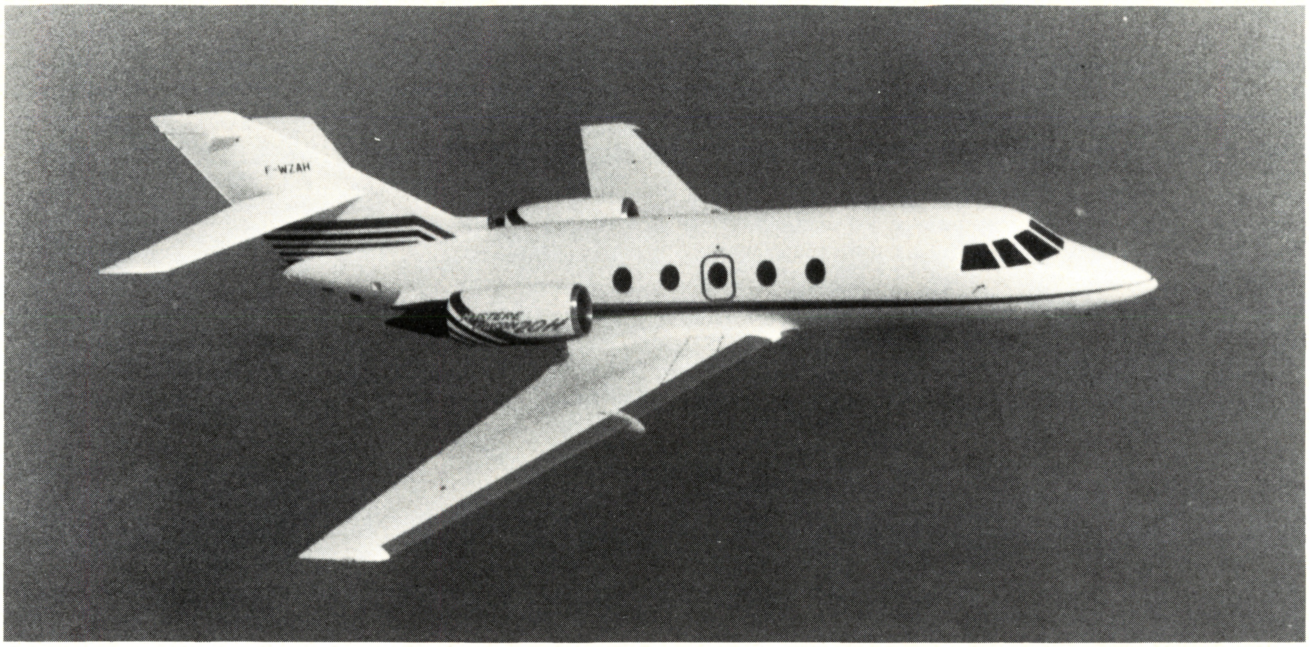


82 Radar display
83 SSO's swivelling seat
84 Cabin rear bulkhead
85 Rear fuselage fuel tank
86 Emergency equipment stowage compartment
87 Rear pressure bulkhead
88 Cabin pressurisation valves
89 Starboard engine nacelle
90 Nacelle tail fairing
91 Air conditioning ram air intake
92 Rear fuselage integral fuel tank
93 Air conditioning plant
94 Hydraulic reservoirs
95 Tailplane autopilot controllers
96 Rudder control rod
97 ADF sense and LORAN aerials
98 Tailplane trim jack
99 Tailplane sealing plate
100 Elevator power control unit
101 Tailfin construction
102 Rudder power control unit
103 Starboard tailplane
104 Starboard elevator
105 VOR aerial
106 Glassfibre fin tip fairing
107 UHF/VHF-FM aerial
108 Anti-collision light
109 Tail navigation lights
110 Static dischargers
111 Rudder construction
112 Port elevator
113 Tailplane construction
114 Leading edge nose ribs
115 Tail cone
116 APU exhaust duct silencer
117 Garrett airborne auxiliary power unit (APU)
118 Sloping fin attachment bulkhead
119 Cooling air exhaust ports
120 Engine pylon tail fairing
121 Control ducts and piping runs
122 Bleed air system pre-cooler
123 Engine accessory compartment
124 Aerial photography electronic flash unit
125 Engine air exhaust duct
126 Garrett AiResearch ATF3-6-2C reverse flow turbofan engine
127 Main engine mounting
128 Hot stream exhaust nozzles
129 Oil cooler baffles
130 Fan casing
131 Engine air intake duct
132 Flap drive motor
133 Fuselage frame and stringer construction
134 Main undercarriage wheel well
135 Undercarriage mounting beam
136 Inboard Fowler flap
137 Spoiler hydraulic jack
138 Flap screw jacks
139 Port spoiler housing
140 Outboard Fowler flap construction
141 Flap down position
142 Port aileron construction
143 Aileron hinge control
144 Static dischargers
145 Glassfibre tip fairing
146 Port navigation light
147 Leading edge slat open position
148 Aileron power control unit
149 Fuel filler cap
150 Wing integral fuel tank
151 Slat guide rails
152 Slat jacks
153 Wing skin plating
154 Port wing fence
155 Twin mainwheels
156 Levered suspension axle beam
157 Main undercarriage leg strut
158 Hydraulic retraction jack
159 Inboard slat jacks
160 Telescopic de-icing air duct
161 Aileron control rod
162 Wing rib construction
163 Wing skin attachment bolted strap joint
164 Centre section carry-through structure
165 Aileron autopilot controller
166 Wing root leading edge fairing

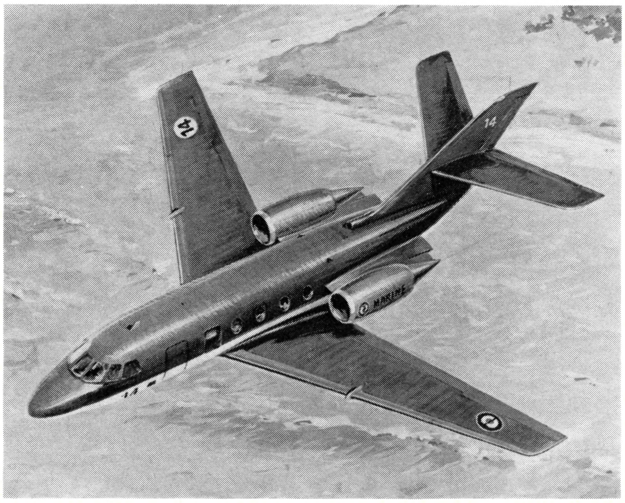
Dassault-Breguet HU-25A Guardian Specification

Power Plant: Two Garrett AiResearch ATF3-6-2C turbofans each rated at 5,440 lb st (2 468 kgp) for take-off. Fuel capacity, 1,269 Imp gal (5 770 l) in wing and fuselage tanks.
Performance: Max cruising speed, M = 0·80, 531 mph (855 km/h) at 40,000 ft (12 200 m); economical cruising speed, M = 0·72; minimum low-altitude manoeuvring speed, 173 mph (278 km/h); take-off run, max weight, ISA at sl, 4,050 ft (1 235 m); max range with crew of five, 5 per cent fuel reserve plus 30 min, 2,590 mls (4 170 km).
Weights: Empty, 19,000 lb (8 620 kg); equipped empty, with five crew and complete avionics, 20,890 lb (9 475 kg); max fuel, 10,220 lb (4 636 kg); max take-off weight, 32,000 lb (14 515 kg); max zero fuel, 22,520 lb (10 215 kg); max landing, 27,580 lb (12 510 kg).
Dimensions: Span, 53 ft 6 in (16,30 m); length, 56 ft 3 in (17,15 m); height, 17 ft 5 in (5,32 m); undercarriage track, 12 ft 1¼ in (3,69 m); wheelbase, 18 ft 10 in (5,74 m); wing area, 450 sq ft (41,80 m^2); aspect ratio, 7·02:1.
Accommodation: Crew of five for US Coast Guard MRS mission, comprising two pilots, surveillance system operator and two visual observers. Three passenger seats on port side of the cabin.

**The ATF3-6, which is itself a major redesign of the 4,000 lb st (1 800 kgp) YF104 variant used in the Compass Cope, is the first engine in its class to be certificated in accordance with FAR 33 Amendment 6, with its stringent requirements in respect of sand and ice ingestion and bird impact.*



(Above) The prototype Falcon 20H, which is now the planned commercial variant of the basic aircraft with ATF 3 engines. The smaller wing fences are apparent. (Below left) An impression of the Gardian in Aéronavale colours, this being the name by which the maritime surveillance version of the Falcon 20H is to be known in France.



delivery of an operational HU-25A now appears to be September 1981, although at least two aircraft should be available meanwhile for crew training.

These problems apart, the Garrett ATF3-6 adopted for the Falcon 20G (and more recently for the commercial Falcon 20H, as noted later) is of major significance in providing enhanced performance and matching the higher gross weight required to allow carriage of the mission equipment. Although the CF700 used in the earlier Falcon variants is itself a turbofan, it is of an earlier generation and the ATF3 has a markedly better sfc. As the higher power of the new engines is matched by increased fuel capacity in the Falcon 20G, the better specific consumption and better specific air range (in terms of miles per lb of fuel) produce a significant increase in actual range: the improvement is of the order of 27 per cent at low altitude in typical search missions and over 20 per cent at high altitudes cruising at Mach = 0·7. The extra fuel, totalling 130 Imp gal (590 l), is carried in an auxiliary tank in the rear fuselage, immediately behind the aft cabin bulkhead, and brings total fuel capacity to 1,270 Imp gal (5 770 l).

The engines for the HU-25A are identified as ATF3-6-2Cs, variants of the ATF3-6 that are specially adapted for the Coast Guard aeroplanes. The special features of the -2C version are an additional 6,000 rpm drive in the accessory pack to power a second hydraulic pump (required to drive an additional electrical generator) and the use of aluminium instead of magnesium for the accessory pack casing, to improve corrosion-resistance in the overwater environment in which the Guardian will spend much of its time.

Airframe changes to allow the Falcon to meet the Coast Guard mission, apart from the extra fuel tank and the new engine installation, are relatively minor, and comprise the installation of a wide-vision search window each side at the front of the cabin (in place of the standard windows), provision of a hatch in the cabin floor for the dropping of survival kits, fitting a side-looking camera port and providing hardpoints under the wings and fuselage to carry sensor pods. Two wing points are stressed for loads of 1,450 lb (660 kg) each, and two for 1,120 lb (507 kg); there are also four strong points under the fuselage, two stressed for 1,100 lb (500 kg) each and two for 440 lb (200 kg) each. The aircraft gross weight is increased from the 28,660 lb (13 000 kg) of the Falcon 20F to a maximum of 32,000 lb (14 500 kg).

Internally, the Coast Guard's HU-25A is laid out to be operated by a five-man crew, comprising two pilots, an SSO (surveillance system operator) and two observers, seated alongside the enlarged windows. With most of the starboard side of the cabin occupied by radio and avionics equipment, there is space to port for a three-seat couch for additional passengers.

As already noted, the Guardian is "all-American" so far as its avionics and other mission equipment is concerned. Collins Avionics Division of Rockwell International is the primary contractor for the surveillance avionics package, which includes a fully-coupled three-axis APS-80 autopilot, with autothrottle for IAS hold, angle-of-attack hold and best range/endurance airspeed hold; and CMS-80 cockpit management system integrating with the area navigation system which includes VOR, Loran C, inertial sensor and DME, and communications equipment which includes dual VHF AM, single VHF FM and dual SSB HF. The search radar, fitted in the nose in place of the usual weather radar, is Texas Instruments APS-127, also integrated with the area navigation system to give the Guardian the ability to locate and maintain surveillance of targets that have not been detected visually from the aircraft. A target located by the radar, and displayed on the SSO console, can be isolated by the operator and its position can then be continuously tracked by the aircraft's management system, regardless of whether the target remains in radar contact.

The aircraft's ability to fulfill the various Coast Guard missions will be enhanced by the carriage of an integrated sensor package externally, under the code name of Aireye. This package, to be carried in separate pods on the wing and fuselage hardpoints, is to include a variant of the Motorola APS-94 side-looking airborne radar, Texas Instruments IR line scanner, Chicago Air Industries KS-87B camera and a laser-illuminated LLLTV. Current plans are for six complete packages to be purchased by the Coast Guard, and for all 41 of the Guardians to be equipped to carry them; installation time is specified to be less than 4 hrs.

The Coast Guard estimated, when studying the practicability of buying a single aircraft type to meet its MRS requirement, that search and rescue missions will account for some 28·5 per cent of the total hours to be flown by the new fleet. The largest single requirement is marine environmental protection, accounting for 30·3 per cent, and the next most important aspect of the Guardian's work is expected to be the "enforcement of laws and treaties" at 18·9 per cent. Other types of mission noted by the Coast Guard were: marine science activities, 10·6 per cent; logistics support, 5·4 per cent; engineering support, 3·8 per cent; domestic icebreaking, 1·7 per cent and flights connected with short-range aids to navigation, 0·8 per cent.

From Guardian to Gardian

When the Falcon 20G was first announced by Dassault-Breguet, the company indicated its intention of offering the ATF3-engined version for commercial use. Subject to engine availability, it was proposed to start the commercial programme by retrofitting existing Falcons, and by March 1977, Falcon Jet Corporation had accepted 35 deposits for such retrofits (at a unit price of $1,495,000). With 5,050 lb st (2 290 kgp) ATF3-6-1C engines, the Falcon 20G was expected to be certificated in March 1979 and the retrofit was intended to include other modifications, such as increases in zero fuel and max take-off weights by 600 lb (270 kg), rudder deflection increased to a maximum of 36 deg, with installation of a new servo; revised cockpit panels and instruments; a new air conditioning system and an anti-icing system.

Largely because of the delays in certification of the ATF3-6, this programme was eventually abandoned, and the Falcon 20G designation is now applicable only to the HU-25A Guardian for the US Coast Guard. It has been superseded commercially by the Falcon 20H, announced in mid-1979 and now expected to be available from the beginning of 1983 for civil use. Following certification of the Falcon 20H later in 1981, the company also now plans to revive its retrofit programme, for the Falcon D, E and F variants to be converted to Falcon 20H standard.

Using the same basic engine installation as the Falcon 20G, the 20H differs in having a number of features that the company has meanwhile developed in the course of design and production of the three-engined Falcon 50, largest of the three members of the Falcon family. Most significant of these features is the rear fuselage tank, which in the Falcon 20H has a capacity of 189 Imp gal (860 l) — the same as that used in the Falcon 50 and substantially larger than the new tank introduced in the Falcon 20G. Also based on the Falcon 50 experience, the systems in the Falcon 20H have been extensively modified for improved performance, greater reliability, easier maintenance and reduced weight. Complete spares interchangeability between Falcon 50 and Falcon 20H is achieved by introducing, in the latter, a new duplicated hydraulic system with separate pumps; two segregated electrical systems of increased power; a new ABG/SEMCA air conditioning system; an automatic stability system, Mach trim, yaw damper and flap asymmetry limiter; and, as options, a Solar T62 APU and the Collins APS-80 autopilot already specified for the HU-25A Guardian. Gross weight of the Falcon 20H is increased, like that of the 20G, to 32,000 lb (14 500 kg), and the aft limit CG position is moved back from 28 to 35 per cent, thanks to the introduction of a system that automatically extends the inboard wing leading-edge slats at high angles of incidence. The cabin of the Falcon 20H is unchanged in size from that of the earlier aircraft, and various layouts for 8 to 14 passengers are available.

Before commercial deliveries of the Falcon 20H begin, Dassault-Breguet is committed to the delivery of five examples ordered in 1977 by the *Aéronavale* (French Navy) in the maritime surveillance rôle for service in the Pacific. These aircraft — and any similar future sales — have been given the

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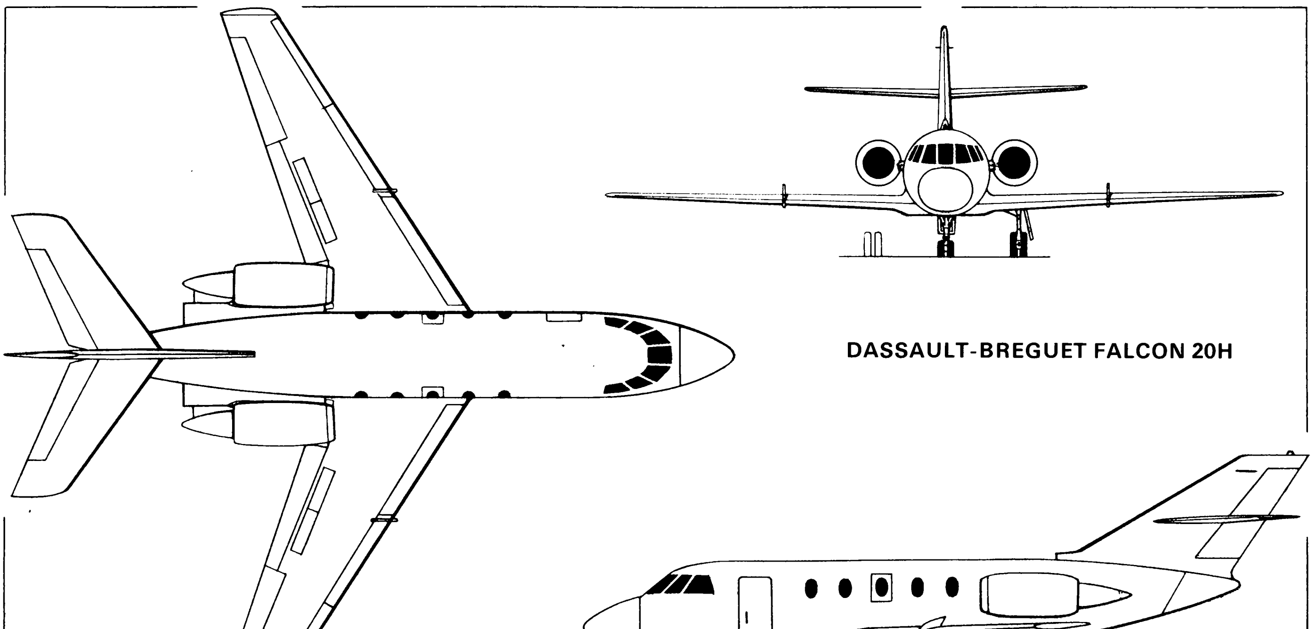
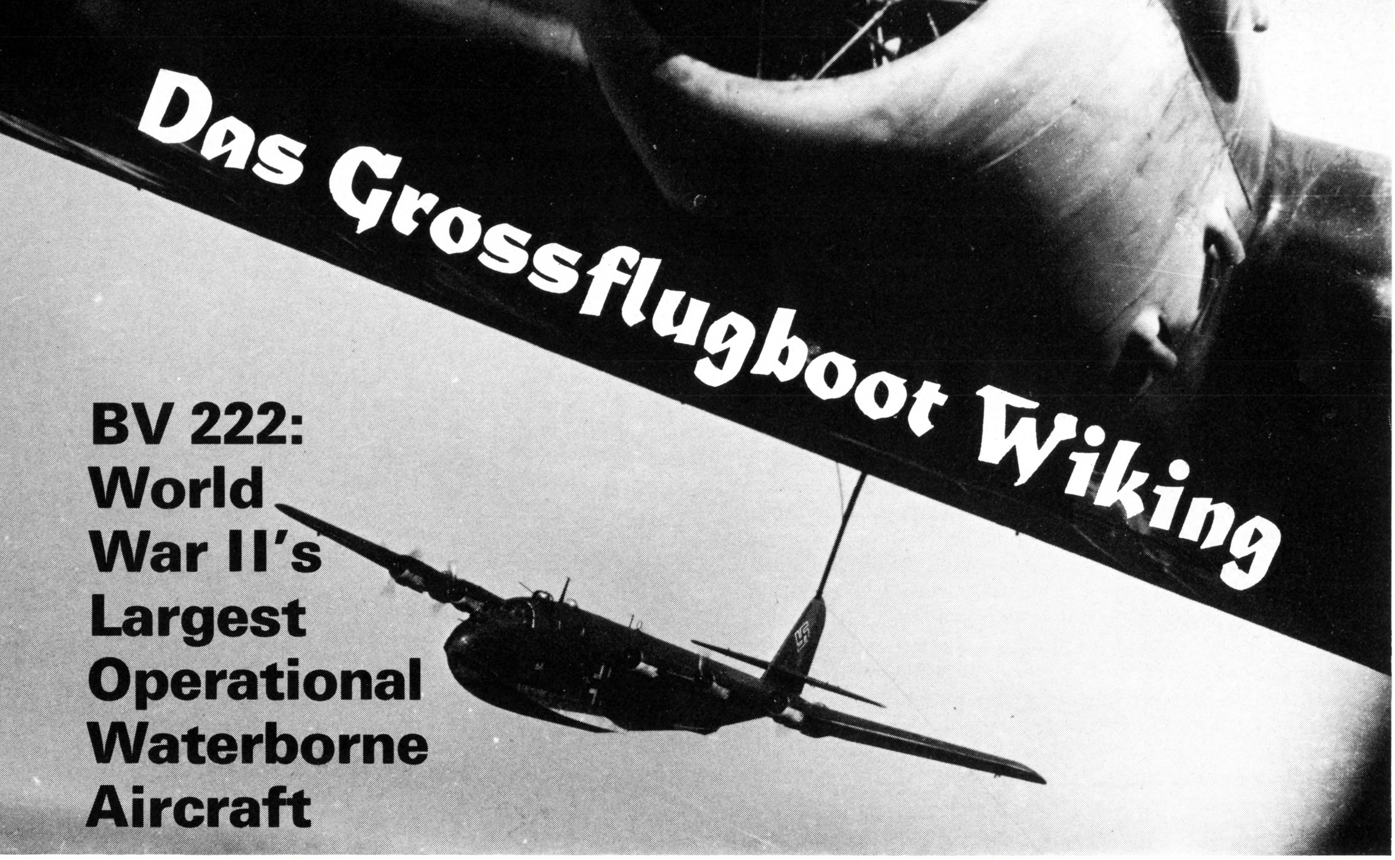


DASSAULT-BREGUET FALCON 20H



Das Grossflugboot Wiking

BV 222: World War II's Largest Operational Waterborne Aircraft

Viewed from the Cockpit

by Captain Eric Brown, CBE, DSC, AFC, RN

THE IMMENSE FLYING BOAT roared down the Norwegian fjord, the noise in the cockpit generated by water pounding the hull being but a decibel or so short of stupefying. My supposed mentor, a *Luftwaffe* major, hunched sullen and apparently preoccupied in the first pilot's seat, had opened the master throttle lever, but response had been somewhat short of the surge of power that I had anticipated and acceleration would have been *flatteringly* described as sluggish! Occupying the co-pilot's seat, I had my hands lightly on the double-horn control wheel and my feet lightly on the rudder pedals which I could feel moving to counteract a slight swing to port. We thundered along the fjord . . . two miles . . . three miles . . . still no sign of the boat getting onto its step. At the rate we were going, the boat bid fair to traverse the entire length of the fjord and head out into the Atlantic *on the surface*. Something was quite obviously wrong!

I had felt no movement of the control wheel and when I applied some back pressure there was no response. The flight engineer was occupying the jump seat between the two pilots' seats, and as the *Luftwaffe* major seemed content to allow the boat to remain on the fjord's surface, I reached across the engineer, knocked his hand away and fully retarded the master throttle, BV 222C-012 immediately losing way and rapidly coming to a standstill. The closing phase of this little drama has no place in this narrative and it suffices to say that the elevator control had been locked and the *Luftwaffe* major was locked up shortly thereafter. At least, the one example of this mighty flying boat available for ferrying to the UK and subsequent evaluation — all other surviving examples had been destroyed by their crews, apart from C-011 and C-013 that had been promptly sequestered by US forces — was unscathed.

It was July 1945, and I had arrived at Trondheim after having been assigned the task of checking out the one Blohm und Voss BV 222 Wiking (Viking) flying boat that had fallen into our hands. The CO Experimental Flying at RAE Farnborough had decided that, since I was a Naval Officer and had flown the Walrus and Sea Otter, I was just the boy for this job. It was rather a case of Hobson's choice as no other RAE pilot had ever been near a waterborne aeroplane. The idea was that I should check out the boat and then return to brief the CO, Grp Cpt Alan F Hards, an ex-Coastal Command wallah, who would then fly the monster from Trondheim to RAF Calshot.

Since we had captured quite a number of Blohm und Voss design personnel, including Dr-Ing Richard Vogt, leader of the BV 222's design team, and had taken them to the UK for interrogation by RAE scientists, I had at least been able to draw on this source of information for some pre-flight briefing. The primary interest of the RAE in the BV 222 was the somewhat complex system of flying controls that it embodied, this involving the use of servo-tabs, and a set of RAE-designed servo-tab controls was to be fitted to a Lancaster II on which I was to carry out the initial flight testing.

Dr-Ing Vogt revealed that the BV 222 was intended from the outset as the forerunner of an even larger machine (ie, the BV 238) and that the servo-tab control system was selected in preference to an even more sophisticated power assistance system as it was likely to give less production repeatability trouble, a lower maintenance load and a more desirable method of emergency operation. In fact, the system was not pure servo-tab control, but part servo and part manual, presumably because the Blohm und Voss team lacked the confidence to go for a pure servo-tab system without previous practical experience. Be that as it may, I had to become thoroughly conversant with the system that had been adopted before heading for Trondheim and the BV 222.

Each aileron was divided into two unequal sections, the large inboard section being fitted with a servo-tab which had a follow-up ratio of 0·6, both aileron and tab being aerodynamically balanced and the balance system consisting of Blohm und Voss-patented "paddles" — differentially-controlled wind vanes previously employed by the tri-motored BV 138 (see November 1979 issue). The "paddle" balance permitted an adjustment of the force to apply aileron and also enabled the pilot to adjust the stick-free dihedral stability as required. The smaller outboard section of the aileron was operated by servo motor through a complex gearing action, but with the linkage direct to the pilot's control wheel, while its trim tab was operated from the cockpit through rotating rods. Thus, both aileron sections moved in unison in response to the controls under normal circumstances, and in the event of the control linkage being severed, both sections were designed to float neutral.

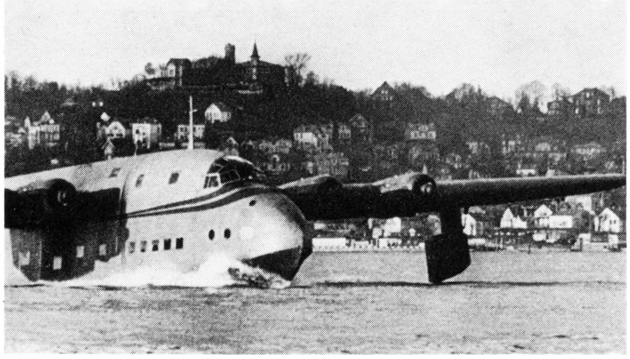
Each elevator was divided into three sections, the outboard section being used only for trimming and operated by an electric motor, the switch for this being adjacent to the flap control to ease the trimming out of pitching movements with the application of flap. The centre portion of the elevator was also driven by an electric motor, but was not connected to the pilot's wheel and had its tab locked central. This could be utilised as a normal power-operated surface activated by the electric motor, be operated by the auto pilot, moving according to the attitude of the aeroplane, or be disconnected from the motor and allowed to float in the trailing position. These actions could be effected independently of the operation of the inboard and largest elevator section which worked on a servo-tab system in the same way as the main part of the aileron. The rudder, simplest of the moving control surfaces, comprised a single section operated by two servo-tabs connected together and having the same follow-up ratio of 0·6 as on the ailerons. The tabs were mass-balanced and an hydraulic damper had been inserted in the circuit and earthed at the fin spar to restrict the operating speed of the tabs.

A waterborne colossus

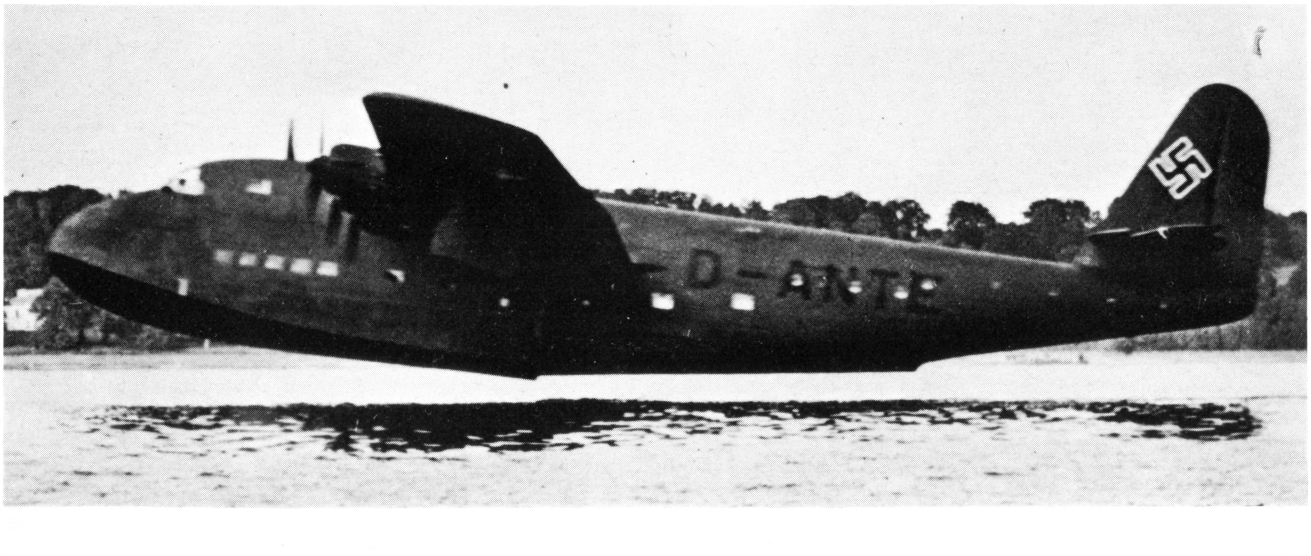
Armed with this knowledge, I had set out for Norway, having, as a precautionary measure, arranged to break my journey at Schleswig, where I knew there to be some flying boats that had been captured at the Schleswigsee seaplane base. There I made dual and solo flights with the BV 138, after which my confidence in my abilities as a flying boat pilot began to mount, and by the time that I arrived at Trondheim with my two flight engineers I was positively itching to get my hands on the controls of the trimotor boat's very much larger stablemate. However, my first sight of the giant BV 222 cooled my ardour somewhat. It rode at its moorings in the fjord like some floating colossus, and its sextet of six-cylinder Diesel engines looked dirty, somewhat weary and definitely small to lift this mighty beast from the water.

Our local forces had a *Luftwaffe* crew available to give us a guided tour of the boat and a very impressive tour it turned out to be. The hull proved to be incredibly spacious as, from the floor up, there were no bulkheads, although there were two decks, with the flight crew on the upper deck and some of the gunners on the lower deck. The normal flight crew was intended to comprise 11 members, consisting of two pilots, two flight engineers, a navigator, a radio operator and five gunners. The structure was conventional enough, apart from the typical Blohm und Voss 4 ft 9 in (1,45 m) diameter welded steel tubular wing spar which was sub-divided by bulkheads into six separate fuel compartments each with a capacity of 633·5 Imp gal (2 880 l) of Diesel K 1, the similar number of oil tanks each containing 37·4 Imp gal (170 l). The fuel tanks were pressure-filled from the front wing catwalk, which also gave access to the rear of the engines, and the tanks had to be filled in staggered sequence one, six, two, five, three and four, and with 220 Imp gal (1 000 l) at a time so as to avoid the risk of capsizing — I was informed that if either tanks one or six was emptied separately the boat *would* capsize!

The six Junkers Jumo 207C Diesel engines each offered 1,000 hp at 3,000 rpm for take-off, with a maximum output of



(Below) The BV 222 V1, registered D-ANTE, lifts off the River Elbe at Finkenwerder on an early — possibly the first — test flight. (Above left) The V1 making way at Finkenwerder, with the short-lived addition of cheat lines on the front fuselage. The heading illustration, opposite, shows an operational BV 222A formating on a sister ship.

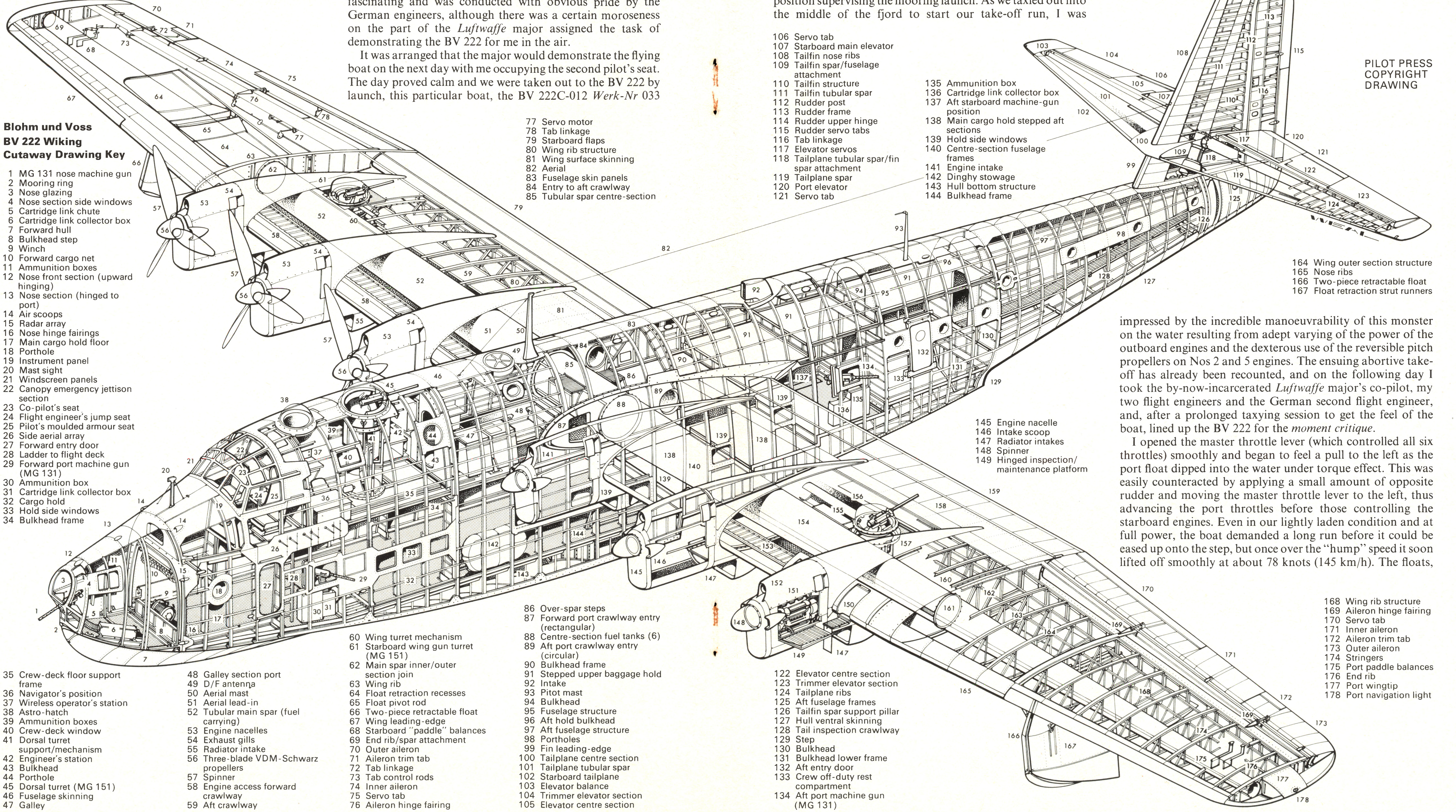


750 hp at 2,500 rpm for 30 min at sea level for climb, and drove 10 ft $9\frac{7}{8}$ in (3,30 m) diam VDM-Schwarz wooden-bladed propellers. It appeared, however, that the Diesels developed insufficient take-off power to lift the fully laden boat within a reasonable distance and therefore provision had been made for the attachment of four solid-fuel take-off assistance rockets beneath the wings, the *modus operandi* being to fire the rockets after 10 seconds full throttle to get the boat over the "hump" speed, these burning for a half-minute and the cases then being jettisoned.

The flight deck, which was reached by a ladder from the lower deck, proved to be exceptionally spacious and beautifully arranged. The first pilot's seat had an armour shield moulded to the shape of the body, and the first flight engineer occupied a jump seat between the two pilots, while the second engineer had a superbly appointed station at the rear of the flight deck. The tour of this big boat was undeniably fascinating and was conducted with obvious pride by the German engineers, although there was a certain moroseness on the part of the *Luftwaffe* major assigned the task of demonstrating the BV 222 for me in the air.

It was arranged that the major would demonstrate the flying boat on the next day with me occupying the second pilot's seat. The day proved calm and we were taken out to the BV 222 by launch, this particular boat, the BV 222C-012 *Werk-Nr* 0330012, having been completed late in 1943 as the last but one of its kind built. We boarded the flying boat and checked that we had only about one-third fuel load as there were no take-off assistance rockets available and at anything like normal loaded weight the take-off run would have been forever. I watched the starting drill for the six Diesel engines carried out by the second engineer and settled myself in the right-hand seat, noting how good the forward view was as the unmooring process took place with the first engineer in the lower nose position supervising the mooring launch. As we taxied out into the middle of the fjord to start our take-off run, I was impressed by the incredible manoeuvrability of this monster on the water resulting from adept varying of the power of the outboard engines and the dexterous use of the reversible pitch propellers on Nos 2 and 5 engines. The ensuing abortive take-off has already been recounted, and on the following day I took the by-now-incarcerated *Luftwaffe* major's co-pilot, my two flight engineers and the German second flight engineer, and, after a prolonged taxying session to get the feel of the boat, lined up the **BV** 222 for the *moment critique*.

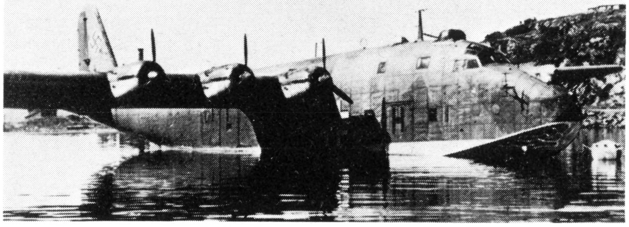
I opened the master throttle lever (which controlled all six throttles) smoothly and began to feel a pull to the left as the port float dipped into the water under torque effect. This was easily counteracted by applying a small amount of opposite rudder and moving the master throttle lever to the left, thus advancing the port throttles before those controlling the starboard engines. Even in our lightly laden condition and at full power, the boat demanded a long run before it could be eased up onto the step, but once over the "hump" speed it soon lifted off smoothly at about 78 knots (145 km/h). The floats,



Blohm und Voss BV 222 Wiking Cutaway Drawing Key

1 MG 131 nose machine gun
2 Mooring ring
3 Nose glazing
4 Nose section side windows
5 Cartridge link chute
6 Cartridge link collector box
7 Forward hull
8 Bulkhead step
9 Winch
10 Forward cargo net
11 Ammunition boxes
12 Nose front section (upward hinging)
13 Nose section (hinged to port)
14 Air scoops
15 Radar array
16 Nose hinge fairings
17 Main cargo hold floor
18 Porthole
19 Instrument panel
20 Mast sight
21 Windscreen panels
22 Canopy emergency jettison section
23 Co-pilot's seat
24 Flight engineer's jump seat
25 Pilot's moulded armour seat
26 Side aerial array
27 Forward entry door
28 Ladder to flight deck
29 Forward port machine gun (MG 131)
30 Ammunition box
31 Cartridge link collector box
32 Cargo hold
33 Hold side windows
34 Bulkhead frame
35 Crew-deck floor support frame
36 Navigator's position
37 Wireless operator's station
38 Astro-hatch
39 Ammunition boxes
40 Crew-deck window
41 Dorsal turret support/mechanism
42 Engineer's station
43 Bulkhead
44 Porthole
45 Dorsal turret (MG 151)
46 Fuselage skinning
47 Galley
48 Galley section port
49 D/F antenna
50 Aerial mast
51 Aerial lead-in
52 Tubular main spar (fuel carrying)
53 Engine nacelles
54 Exhaust gills
55 Radiator intake
56 Three-blade VDM-Schwarz propellers
57 Spinner
58 Engine access forward crawlway
59 Aft crawlway
60 Wing turret mechanism
61 Starboard wing gun turret (MG 151)
62 Main spar inner/outer section join
63 Wing rib
64 Float retraction recesses
65 Float pivot rod
66 Two-piece retractable float
67 Wing leading-edge
68 Starboard "paddle" balances
69 End rib/spar attachment
70 Outer aileron
71 Aileron trim tab
72 Tab linkage
73 Tab control rods
74 Inner aileron
75 Servo tab
76 Aileron hinge fairing
77 Servo motor
78 Tab linkage
79 Starboard flaps
80 Wing rib structure
81 Wing surface skinning
82 Aerial
83 Fuselage skin panels
84 Entry to aft crawlway
85 Tubular spar centre-section
86 Over-spar steps
87 Forward port crawlway entry (rectangular)
88 Centre-section fuel tanks (6)
89 Aft port crawlway entry (circular)
90 Bulkhead frame
91 Stepped upper baggage hold
92 Intake
93 Pitot mast
94 Bulkhead
95 Fuselage structure
96 Aft hold bulkhead
97 Aft fuselage structure
98 Portholes
99 Fin leading-edge
100 Tailplane centre section
101 Tailplane tubular spar
102 Starboard tailplane
103 Elevator balance
104 Trimmer elevator section
105 Elevator centre section
106 Servo tab
107 Starboard main elevator
108 Tailfin nose ribs
109 Tailfin spar/fuselage attachment
110 Tailfin structure
111 Tailfin tubular spar
112 Rudder post
113 Rudder frame
114 Rudder upper hinge
115 Rudder servo tabs
116 Tab linkage
117 Elevator servos
118 Tailplane tubular spar/fin spar attachment
119 Tailplane spar
120 Port elevator
121 Servo tab
122 Elevator centre section
123 Trimmer elevator section
124 Tailplane ribs
125 Aft fuselage frames
126 Tailfin spar support pillar
127 Hull ventral skinning
128 Tail inspection crawlway
129 Step
130 Bulkhead
131 Bulkhead lower frame
132 Aft entry door
133 Crew off-duty rest compartment
134 Aft port machine gun (MG 131)
135 Ammunition box
136 Cartridge link collector box
137 Aft starboard machine-gun position
138 Main cargo hold stepped aft sections
139 Hold side windows
140 Centre-section fuselage frames
141 Engine intake
142 Dinghy stowage
143 Hull bottom structure
144 Bulkhead frame
145 Engine nacelle
146 Intake scoop
147 Radiator intakes
148 Spinner
149 Hinged inspection/maintenance platform
150 Leading-edge hinged section
151 Junkers Jumo 207C Diesel engine
152 Upper intake fairing
153 Engine access forward crawlway
154 Tubular main spar
155 Aft crawlway
156 Port wing gun turret (MG 151)
157 Turret mechanism
158 Wing surface skinning
159 Port flaps
160 Wing centre-section structure
161 Main spar inner/outer section join
162 Wing rib
163 Float recess
164 Wing outer section structure
165 Nose ribs
166 Two-piece retractable float
167 Float retraction strut runners
168 Wing rib structure
169 Aileron hinge fairing
170 Servo tab
171 Inner aileron
172 Aileron trim tab
173 Outer aileron
174 Stringers
175 Port paddle balances
176 End rib
177 Port wingtip
178 Port navigation light

(Above) The prototype BV 222 V1 seen during its initial flight test programme in the autumn of 1940. (Below) The BV 222 V2, the second example completed, bearing the codes X4+BH at Biscarosse in 1942.



each of which split vertically, each half folding upward to lie flat within the wing, had to be retracted as soon as the boat was airborne since the electrical process occupied some 20 seconds and had to be completed before the airspeed reached 121 knots (225 km/h).

The controls were surprisingly light and effective in the climb, which was very ponderous and accentuated an oppressive feeling that the flying boat was seriously underpowered. Even at our low weight, it took some 10 minutes to reach 5,000 ft (1 525 m), at which altitude I had determined to try out the controls at a cruise of 156 knots (290 km/h). These really were incredibly light, especially on the ailerons where full application called for a mere 16 lb (7,25 kg) force. The elevators had a stick force per *g* of about 27 lb (12,25 kg), which I found very pleasant, but like the ailerons, they bordered on the dangerously light for so large an aircraft. I decided to try out the rudder control in the asymmetric situation by throttling back an outer engine and letting it windmill, and found no difficulty in holding the boat straight on half rudder with a barely noticeable foot load. Throttling back two outer engines on the port side gave the worst case for directional control, but again the foot load was very reasonable, so I tried lowering the speed and the flaps until full rudder was required to keep straight, achieving a foot load of about 30 lb (13,6 kg), this still being light in view of the situation.

As a check on whether the control forces changed with speed, I dived the boat to 216 knots (400 km/h) and found no measurable change in the elevator or rudder forces with control displacement, although the aileron forces were noticeably heavier. Nevertheless, these were still quite remarkably light for so large an aircraft at that speed. But it was in alighting that the BV 222 really demonstrated the delightful lightness and effectiveness of its controls. After lowering the floats at 108 knots (200 km/h) and the flaps at 97 knots (180 km/h) until the latter reached 20 deg, I turned this leviathan onto the final approach and set the full 40 deg of flap, easing the speed to 81 knots (150 km/h) and allowing this to gradually decay until touchdown at 70 knots (130 km/h). Trimming during the alighting phase was rendered easy by the trim tab box which incorporated a miniature control column moving in the natural sense for longitudinal and lateral trim, and twisting for directional trim.

The alighting process was greatly eased by the exceptional forward view from the flight deck, although on calm water I found height a little difficult to judge from my lofty perch, but this was merely a question of familiarisation. The run-out was surprisingly long, probably due to the high idling speed of the Diesel engines, and I began to see the reason for the two reversible pitch propellers, although I did not need to use them in view of the great expanse of water available to me. When we finally came to a standstill I was more than willing to concur with the views of those claiming that the BV 222 was remarkable not merely for its size but for its controls. The controls were undeniably *very* effective, but, to my mind, they were dangerously light for so huge a machine. This control lightness apparently reflected the philosophy of Blohm und Voss's chief test pilot, *Flugkapitän* Helmut W Rodig, and while I must confess to a predilection for light controls, I would be disinclined to carry the theme to such extremes.

The BV 222C-012 was finally ferried to RAF Calshot, on Southampton Water, by Grp Cpt Hards on 17 July 1945, and he undertook an extensive handling test of the boat a week later. It was subsequently evaluated by the MAEE Felixstowe and, regrettably, broken up at Calshot in 1947. Insofar as my experience with this mighty boat was concerned, it afforded me some standard for comparison when, on 19 December 1947, I made the first flight with the Lancaster II equipped with RAE-designed servo-tab rudders, followed later by servo-tab ailerons and elevators to complete a highly successful control system.

THE HISTORY OF THE BV 222 WIKING

When Germany's foremost shipbuilder, the Blohm und Voss Schiffswerft of Hamburg, established an aircraft-manufacturing subsidiary on 4 July 1933, it was perhaps to be expected that this new organisation would be predisposed towards the development of waterborne aircraft. It was nevertheless surprising that this youthful and relatively inexperienced concern should be selected by Deutsche Lufthansa (DLH) in preference to the immensely more experienced Dornier and Heinkel companies for the development of a transatlantic flying boat only marginally smaller than the largest waterborne aircraft developed to that time, the Dornier Do X.

By 31 May 1937, when the Hamburger Flugzeugbau — as the Blohm und Voss subsidiary was then known — submitted its *Projekt* 54 transatlantic flying boat design study to DLH, the fledgeling company had still to celebrate its fourth anniversary, and its practical experience with waterborne aircraft was limited to two prototypes of its first seaplane, the Ha 139. Nevertheless, on 19 September, the Hamburger Flugzeugbau was recipient of an order for three flying boats.

The definitive DLH specification called for luxurious and spacious accommodation for 24 passengers by day, with an alternative arrangement for 16 sleeping berths. While this was being finalised, a thorough evaluation of the hydrodynamic characteristics of the proposed planing bottom of the new flying boat was undertaken with models by the *Deutschen Schiffsbau-Versuchsanstalt* (DSV). This planing bottom was novel in that the length-to-beam ratio was 8·4 compared with the generally accepted ratio of the order of 6, this having been selected by the Hamburger Flugzeugbau team, headed by Dr-Ing Richard Vogt, in order to reduce both hydrodynamic and aerodynamic drag.

Other novelties proposed included electrically-actuated retractable floats arranged to split vertically, each half rotating through a 90-deg arc to lie flush within the wing, and a part-servo and part-manual control system. The structural design was conventional except insofar as it incorporated the fuel-carrying tubular mainspar that had been developed by Dr-Ing Vogt while working in Japan, this being sub-divided by bulkheads to accommodate six 759 Imp gal (3 450 l) fuel tanks, and carrying via welded steel-tube extensions the six BMW 132H nine-cylinder radial engines by which it was proposed that the massive flying boat was to be powered.

Detail structural design began in January 1938, the designation Ha 222 initially assigned to the flying boat having meanwhile been changed to BV 222 with the change in the title of the Hamburger Flugzeugbau to that of Abteilung Flugzeugbau der Schiffswerft Blohm und Voss. The first metal was cut during the course of the year at Wenzendorf, near Hamburg, while work began on a larger, more modern facility at Finkenwerder where it was proposed that assembly should take place. Despite the commencement of hostilities in September 1939, work on this ambitious commercial flying boat continued unallayed, and on 16 July 1940, DLH representatives inspected a full-scale mock-up of the interior, although it was becoming obvious that the airline stood little chance of adding the BV 222 to its fleet.

Meanwhile, the BMW 132H engines had given place to Bramo Fafnir 323Rs which it was anticipated would be able to offer 200 hp more for take-off with the aid of methanol-water injection, and late in August 1940, the first prototype, the BV 222 V1 *Werk-Nr* 365, was rolled out of the Finkenwerder factory, launched on the Elbe, and, on 7 September flown for the first time with *Flugkapitän* Helmut Rodig at the controls. Sporting the registration D-ANTE, the flying boat was airborne for 20 minutes, Rodig declaring himself generally satisfied with control response, but complaining of some slight directional instability and a tendency to porpoise during taxying.

Flight testing continued from the Elbe, interspersed with brief periods in the Finkenwerder factory for modifications, and the basic flight test programme was virtually complete by December, when the river iced up. Testing was resumed in February 1941, and plans were laid for a series of long-distance flights to demonstrate range and endurance. At this stage, the *Luftwaffe* proposed that these flights should also be supply missions. Cargo doors were therefore cut in the sides of the hull and the interior rearranged to accommodate bulky items of freight. With the civil registration replaced by the radio call sign CC+EQ, and now wearing full *Luftwaffe* markings and camouflage, the BV 222 V1 flew its first supply mission on 10 July 1941.

The BV 222 flew from Hamburg to Kirkenes, Norway, on the Barents Sea, six more flights between Hamburg and Kirkenes being flown by 19 August, totalling some 18,600 miles (30 000 km), about 650 tonnes of freight being carried to Kirkenes and 221 casualties being transported back to Hamburg. While the first prototype was engaged in its proving flights between Hamburg and Kirkenes, the second prototype commenced its test programme from the Elbe, this, the BV 222 V2 *Werk-Nr* 366 CC+ER, taking-off on its maiden flight on 7 August 1941. The decision had meanwhile been taken to place the second and subsequent BV 222s at the disposal of the *Fliegerführer Atlantik*, established in the previous March, additional hulls being laid down for the long-range reconnaissance rôle in collaboration with U-boats, and the V2 having been completed with full defensive armament.

This armament comprised a single 7,9-mm MG 81 machine gun in the bow, fore and aft upper turrets each mounting a single 13-mm MG 131, four MG 81s firing from beam positions in the hull, and one forward- and one aft-firing MG 131 in each of two gondolas mounted beneath the wing and between the outer engine pairs. In the event, trials with the V2 at Travemünde revealed that the drag penalty incurred by the gondolas was greater than could be accepted by what was already tacitly admitted to be an underpowered aircraft, and these appendages were promptly removed. Other modifications directly resulting from the Travemünde test programme included the deepening of the rear hull step by the simple expedient of adding a wedge-shaped auxiliary structure, the addition of five short auxiliary steps immediately aft of the first main step, and some structural strengthening.

The BV 222 V1 resumed its long-distance flights on 10 September 1941, after overhaul at Finkenwerder, these commencing with a mission to Athens from where it was supposed to operate a shuttle service to Derna, Libya. Before

Blohm und Voss BV 222 Wiking Specification

Power Plant: (A-series) Six Bramo Fafnir 323R-2 nine-cylinder radial air-cooled engines each rated at 1,200 hp with MW 50 boost for take-off, 1,000 hp at 2,500 rpm, 800 hp at 2,250 rpm and 640 hp at 2,100 rpm each driving three-bladed variable-pitch VDM-Schwarz propellers of 10 ft 9⅞ in (3,30 m) diam. Internal fuel capacity, 759 Imp gal (3 450 l) in each of six tanks.

(C-series) Six Junkers Jumo 207C six-cylinder vertical opposed-piston compression-ignition two-stroke engines each rated at 1,000 hp at 3,000 rpm for take-off, 750 hp at 2,500 rpm (for 30 min) and 680 hp at 2,400 rpm each driving three-bladed variable-pitch VDM-Schwarz propellers of 10 ft 9⅞ in (3,30 m) diam. Internal fuel capacity, 633·5 Imp gal (2 880 l) in each of six tanks.

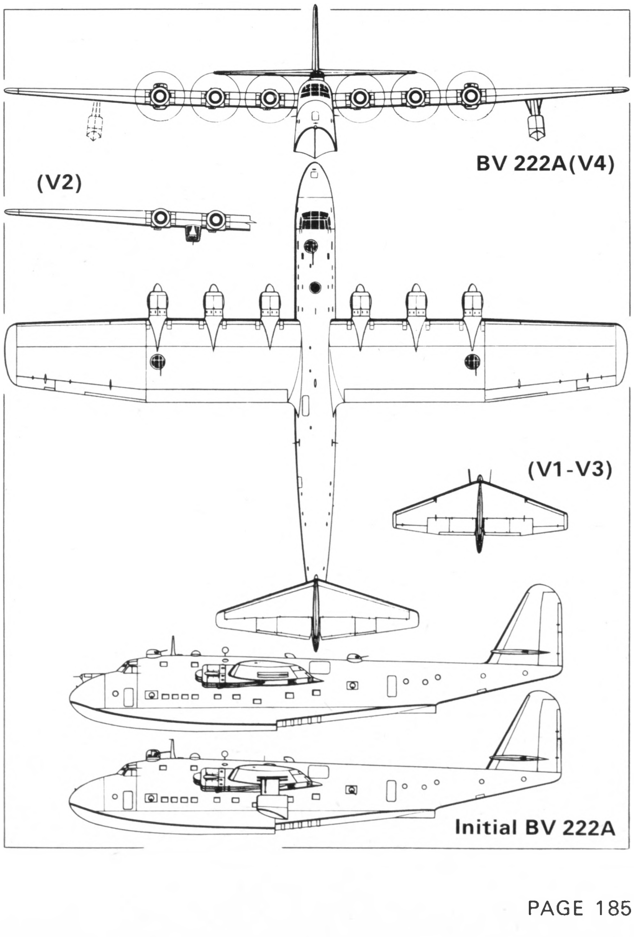
Performance: (A-series) Max speed (at 100,530 lb/45 600 kg) at sea level, 184 mph (296 km/h), (at 77,162 lb/35 000 kg), 193 mph (310 km/h); max continuous cruise (at 100,530 lb/45 600 kg) at sea level, 158 mph (254 km/h), (at 77,162 lb/35 000 kg), 173 mph (278 km/h); econ cruise (at 100,530 lb/45 600 kg), 155 mph (250 km/h), (at 88,185 lb/40 000 kg), 160 mph (257 km/h); max range, 4,350 mls (7 000 km) at sea level, 4,630 mls (7 450 km) at 16,075 ft (4 900 m); optimum flight endurance, 33 hrs at sea level, 23 hrs at 16,075 ft (4 900 m); climb to 19,685 ft (6 000 m), 49 min; service ceiling, 21,325 ft (6 500 m).

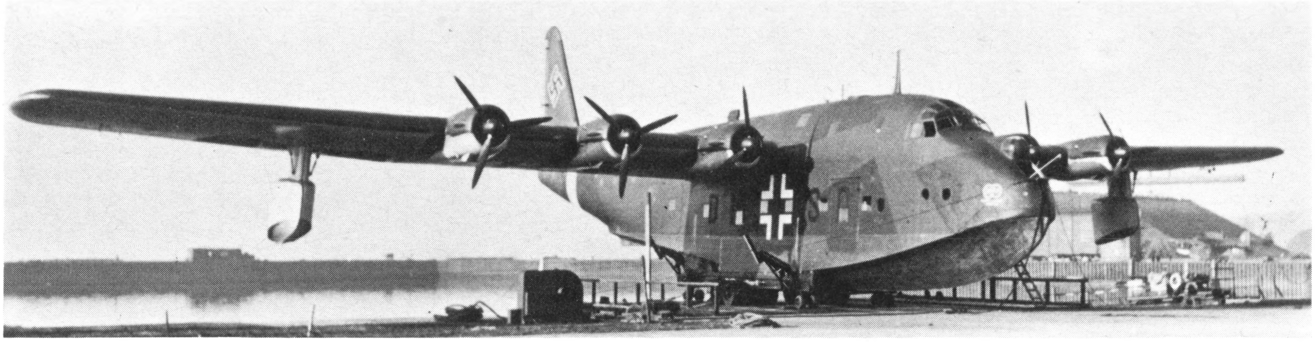
(C-series) Max speed (at 101,390 lb/45 990 kg), 205 mph (330 km/h) at sea level, 242 mph (389 km/h) at 16,405 ft (5 000 m); max continuous econ cruise, 189 mph (304 km/h) at sea level, 214 mph (344 km/h) at 18,210 ft (5 550 m); optimum endurance, 28 hrs at 152 mph (245 km/h) at sea level; max range, 3,790 mls (6 100 km); initial climb (at 101,390 lb/45 990 kg), 473 ft/min (2,4 m/sec); time to 19,685 ft (6 000 m), 52 min; service ceiling, 23,950 ft (7 300 m).

Weights: (A-series) Empty equipped, 62,941 lb (28 550 kg); max loaded, 100,530 lb (45 600 kg).

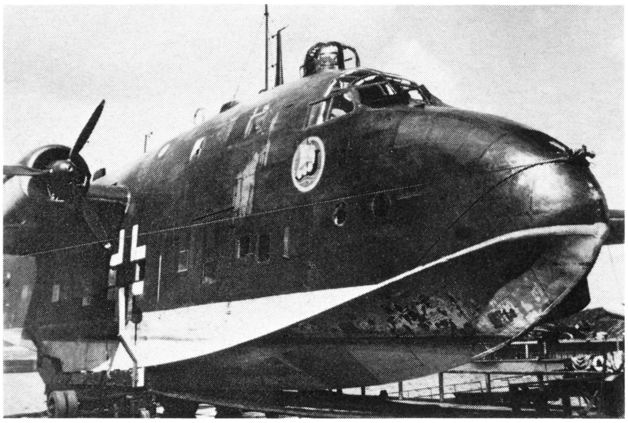
(C-series) Empty equipped, 67,572 lb (30 650 kg); normal loaded, 101,390 lb (45 990 kg); max overload, 108,026 lb (49 000 kg).

Dimensions: Span, 150 ft 11 in (46,00 m); length, (A-series) 119 ft 9 in (36,50 m), (C-series) 121 ft 4⅔ in (37,00 m); height, 35 ft 9 in (10,90 m); wing area, 2,744·8 sq ft (255 m²).





(Above) The third of the big Blohm und Voss 'boats, BV 222 V3, bearing the codes DM+SD prior to delivery from Finkenwerder. (Below left) A close-up of BV 222 V4, the first pre-production A-series Wiking, bearing the emblem of LTS See 222.



this service could begin, however, the flying boat was forced to return to Finkenwerder to have a thick layer of barnacles scraped from its hull owing to the deleterious effect that these were having on both hydrodynamic and aerodynamic performance.

During the period 16 October to 6 November 1941, the BV 222 V1 made 17 return flights between Athens and Derna, carrying 66,140 lb (30 000 kg) of freight and evacuating 515 casualties. During these flights, a maximum speed of 239 mph (385 km/h) was recorded at 14,765 ft (4 500 m), and it was ascertained that up to 72 casualty stretchers or 92 fully-equipped troops could be accommodated. Totally unarmed, the BV 222 V1 was normally escorted by two Bf 110s, but occasionally the fighters missed the rendezvous and the flying boat had to fulfil its mission unescorted. On one such occasion, the lone BV 222 encountered two patrolling RAF Beauforts, but for some inexplicable reason these did not attack the defenceless flying boat.

In November 1941, the BV 222 V1 returned to Finkenwerder to have defensive armament fitted, this being similar to that already mounted by the V2 apart from the underwing gondolas. The BV 222 V3 *Werk-Nr* 439 DM+SD, first flown on 28 November 1941, possessed no armament other than the MG 81 in the bow position, this third prototype being intended purely for the transport rôle, which, for some time, was also to be the task of the BV 222 V2.

Enter the Viking

On 20 January 1942, the BV 222 flying boat was officially named Wiking (Viking) by the *Reichsminister der Luftfahrt*, and by this time a pre-production batch of five of these immense aircraft had reached advanced stages on the Finkenwerder final assembly line. It was envisaged that these boats, powered by Bramo Fafnir 323R-2 radials and considered as A-series machines although allocated *Versuchs* numbers V4 to V8 inclusive, would serve in both transport and maritime reconnaissance rôles. In the event, the fourth of the A-series boats, the V7, was to be modified during construction to take Diesel engines as a C-series prototype.

On 9 December 1941, the BV 222 V3 had been officially taken on strength by the *Luftwaffe* and, as the entire aircraft complement of *Lufttransportstaffel See* 222 V3, had undertaken 21 supply flights between Italian bases and Tripoli in the period January-March 1942. The BV 222 V3, by now coded X4+CH, was joined on 20 April 1942, by the BV 222 V4 X4+DH, and the unit was redesignated *Luftverkehrsstaffel "C"*. The BV 222 V4 *Werk-Nr* 0004 (originally DM+SE) had been completed earlier in the year at Finkenwerder, and embodied some strengthening of the rear hull and the outer wing panels, and a redesigned, longer-span tailplane.

On 10 May, the BV 222 V1 was returned to service after modification and overhaul at Finkenwerder, being assigned to *Luftverkehrsstaffel "C"*, which then became *Lufttransportstaffel See* 222, or LTS See 222, but the complement of the unit remained unchanged owing to the re-assignment of the V3 to the 3.*Staffel* of *Küstenfliegergruppe* 406, a BV 138-equipped unit operating from Biscarosse, for the maritime reconnaissance mission. The complement of LTS See 222 was increased in August, however, with the arrival on the 10th of the BV 222 V2 (now X4+BH) and the BV 222 V6 *Werk-Nr* 0006 X4+FH on the 21st.

The four boats were primarily engaged on flying supply missions from Italian and Greek bases to Rommel's *Afrika Korps*, alighting at Tobruk and Derna, and returning with casualties, and were joined on 26 October by the BV 222 V8 *Werk-Nr* 0008 X4+HH, but a month later, LTS See 222 suffered its first casualty when the BV 222 V6 was intercepted and shot down by RAF fighters on 24 November when flying unescorted south of Pantelleria. This loss resulted in orders that BV 222s would subsequently fly all missions in formation at low altitude. Despite this precaution, on 10 December, the BV 222 V1, V4 and V8 were intercepted by a trio of RAF Beaufighters while flying in formation at low altitude over the Mediterranean en route to Tripoli. The BV 222 V8 was shot down and the V4 suffered heavy damage but succeeded in reaching Tripoli in company with the V1.

Reporting on the latter incident, the LTS See 222 *Staffelkapitän* wrote: "It has now been proven that the defensive armament of the BV 222 is totally inadequate. Low-level flying, accepted hitherto as the best means of defence, is now seen to be of little value as any fighter can position itself behind the tail so that it is flying a good three metres lower than the flying boat, and once so positioned it cannot be hit by any of the existing defensive guns. Furthermore, while flying in formation it is almost impossible for the BV 222 to take evasive action." A direct result of this report was the decision to fly all further supply missions by night until effective defensive armament could be provided, but it was soon to be discovered that such nocturnal operations were subjected to hazards equally as dangerous as that of encountering enemy fighters during daylight missions.

As the North African ports at which the BV 222s were intended to alight were being attacked by bombers virtually every night, no lights could be displayed to guide the flying boats once on the water, and the risk of holing as a result of striking floating debris or submerged obstacles while taxying was extremely high. Indeed, the BV 222 V1 foundered in the harbour at Athens in February 1943 when it struck a marker buoy at speed, ripping several yards of skinning from its planing bottom. LTS See 222 was therefore stood down and the surviving Wikings returned to Travemünde for re-arming and other modifications.

The fact that the BV 222 was manifestly underpowered had been a matter of considerable concern to the Blohm und Voss team from an early stage in the development of the flying boat. The A-series boats were not, in fact, to be equipped with the planned methanol-water injection system for boosting take-off power until the summer of 1942, and then the maximum permissible take-off weight was raised from 99,206 lb (45 000 kg) to 105,820 lb (48 000 kg). The Bramo Fafnir 323R-2 engines each afforded 1,000 hp at 2,500 rpm, 800 hp at 2,250 rpm and 640 hp at 2,100 rpm, MW 50 boosting take-off power to 1,200 hp.

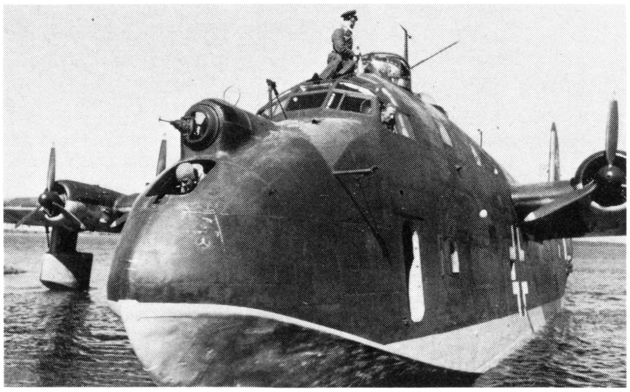
From the outset, Junkers Jumo Diesel engines had been favoured for their economy, although in service such engines were proving temperamental and demanding on skilled maintenance. The definitive model planned for DLH had been the BV 222B with six Jumo 208 Diesel engines each rated at 1,500 hp at 2,800 rpm and 1,000 hp at 2,500 rpm, but Junkers had failed to take the Jumo 208 beyond the bench-testing stage. Proposals originally made to the RLM in 1939, which included *Projekt* 97 with six BMW 801 air-cooled radials and *Projekt* 98 with four BMW 801s, were resurrected, but the RLM was adamant that such engines be reserved for other aircraft types.

Finally, the *Technische Amt* of the RLM accepted Blohm und Voss's proposals that Jumo 207C Diesels affording 1,000 hp at 3,000 rpm be installed in the fourth A-series flying boat, the BV 222 V7, Junkers promising a further development of this engine, the Jumo 207D with MW 50 boost which would provide the desired short-term take-off power, for installation in later production boats. The BV 222 V7 was intended from the outset primarily for the long-range reconnaissance rôle. Fuel tank capacity was decreased, each of the six mainspar tanks accommodating 633·5 Imp gal (2 880 l) of Diesel K 1 as compared with the 759 Imp gal (3 450 l) of gasoline of the A-series aircraft tanks, the capacity of the six oil tanks each being raised to 37·4 Imp gal (170 l) from 19 Imp gal (86 l). Normal loaded weight was 101,390 lb (45 990 kg) and maximum overload weight was 108,026 lb (49 000 kg), and at neither weight did the Jumo 207C Diesels deliver sufficient power for take-off without an excessively long run. Provision was therefore made for the attachment of four solid-fuel take-off rockets beneath the wings, these being fired after 10 seconds at full throttle and burning for 30 seconds.

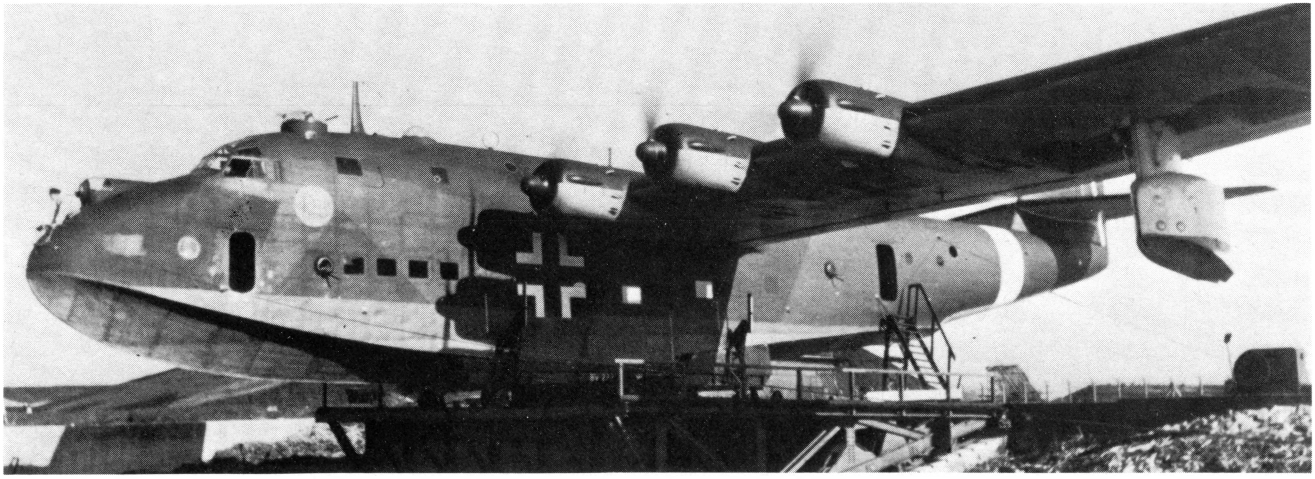
The surviving BV 222 flying boats had meanwhile standardised on a revised defensive armament which now incorporated a forward dorsal turret with a 20-mm MG 151 cannon, a similar weapon in each of two turrets mounted in the wings immediately aft of the extreme outer engine nacelles, a 13-mm MG 131 machine gun firing from a forward beam position and two 7,9-mm MG 81s from aft beam positions, the aft dorsal turret and the bow gun being deleted. The BV 222 V7 reinstated the bow position, however, adding an additional forward beam MG 131 and supplanting the rear beam MG 81s with MG 131s. Furthermore, it featured repositioned wing turrets which were now situated in the rear ends of engine nacelles two and five.

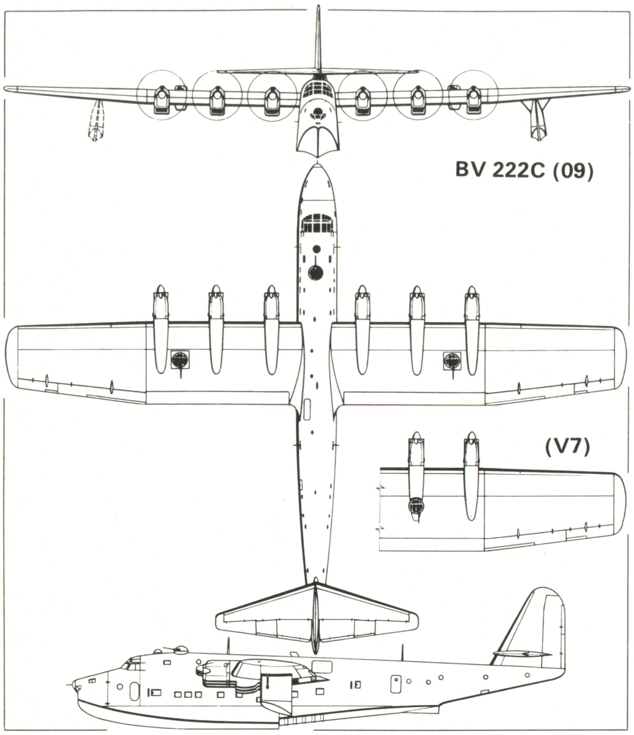
Search radar was fitted and additional radio aids included FuG 200 *Hohentwiel*, FuG 16Z VHF radio with direction and range measuring facilities, FuG 25a IFF, and an FuG 101a radio altimeter. An ETC 501 rack was fitted to carry an FuG 302c *Schwan* (Swan) beacon. Similar equipment was simultaneously installed in the remaining A-series boats as it had become obvious that Axis resistance in North Africa was collapsing and that the BV 222s would be best employed in co-operation with the U-boat fleet in the Atlantic under the control of the *Fliegerführer Atlantik*.

The Diesel-engined BV 222 V7 *Werk-Nr* 031 0007 TB+QL flew for the first time on 1 April 1943 as the prototype of the C-series, work on several pre-production examples of which had been initiated some time before the completion of the last A-series aircraft, the BV 222 V8. In fact, the BV 222C-09 *Werk-Nr* 031 0009 was completed only six weeks after the V7 and was actually to precede the Diesel-engined prototype into service with the *Fliegerführer Atlantik*, being taken on strength by *Aufklärungsstaffel See* 222 on 23 July 1943. This unit had been formed in May with the V2, the V3, the V4 and the V5 as a component part of 3./Kü.Fl.Gr.406, but had lost two of the



(Above right) Close-up of an anonymous BV 222A in Luftwaffe *service, showing the 7,9-mm MG 81 machine gun in the bow turret that was later deleted from the A-series. (Below) The last of the A-series 'boats, the V8, in service with LTS See 222.*



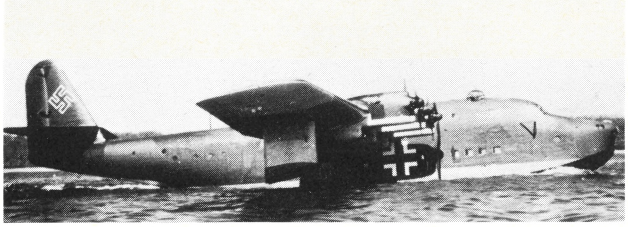


boats, the V3 and the V5, in the following month when they were strafed and sunk at their moorings at Biscarosse. The BV 222C-09 differed from the V7, which was to join *Aufklärungsstaffel See* 222 on 16 August 1943, essentially in the positioning of the defensive wing turrets, these being located slightly further forward and between the outboard engine pairs, and extended beneath the wing to provide adequate leg room for their gunners.

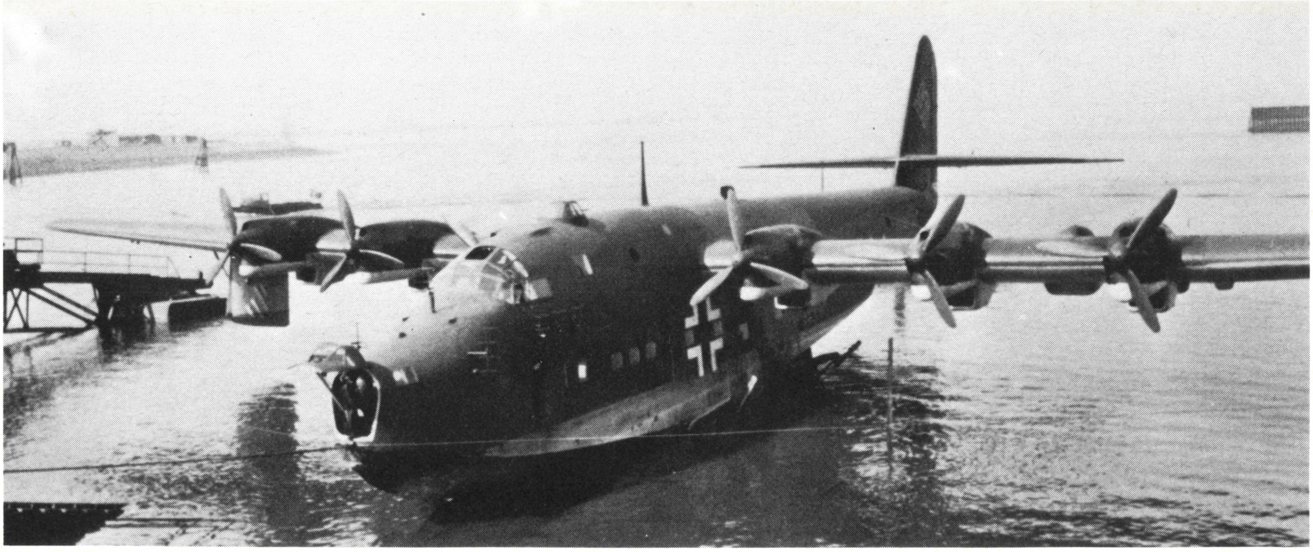
The BV 222C-010 *Werk-Nr* 031 0010 had been added to the Biscarosse-based unit by October 1943, when the *Aufklärungsstaffel See* 222 was redesignated 1.*Staffel* of *(Fern)/See-Augklärungsgruppe* 129, its flying boats ranging far out over the Atlantic on U-boat co-operation tasks, and in October 1943, one of the BV 222s encountered and shot down a patrolling Lancaster. The BV 222C-011 and C-012 followed the C-010 from the Finkenwerder factory at short intervals, the time to build a hull in the gantry having by now been reduced to six weeks by dint of working shifts around the clock, the complete airframe being produced in an average of 350,000 manhours, the detail manufacturing and subassembly being mainly undertaken at the Steinwerder branch factory.

The BV 222C-013 was the first airframe in which it was proposed to install the more powerful Jumo 207D Diesels as the prototype BV 222D, but as these failed to materialise, the boat had to be completed with the lower-powered Jumo 207C engines. Four additional airframes had been under construction which it had been intended to complete as BV 222Ds, but, meanwhile, the RLM had ordered the cessation of further development and production of Diesel engines and, failing the availability of more suitable power plants, Blohm und Voss had no recourse but to revert to the Bramo Fafnir 323R-2s of the A-series. With these radials installed it was intended to designate the four additional boats as BV 222Es, but in the event, early in 1944, it was concluded that the aircraft industry could no longer afford the large labour force demanded by the BV 222, the production programme being cancelled and the four boats under construction being scrapped.

The 1.(F)/SAGr.129 continued operations from Biscarosse, losing the BV 222C-010 to RAF night fighters early in 1944, but in July, following the D-Day landings, the unit was disbanded, the four BV 222s remaining on strength being reassigned to the *Stab* and 1.(F)/SAGr. 130 and 2.(F)/SAGr. 131, the former being primarily BV 138-equipped and the latter operating a mix of BV 138s and Ar 196As. As the war situation progressively deteriorated, the BV 222s were increasingly relegated to transport tasks and only one other example, the BV 222C-09, was lost to enemy action before fighting terminated in Europe, this being strafed and damaged beyond repair by RAF fighters at Travemünde early in 1945. Of these immense flying boats that survived the conflict, the BV 222 V2 was blown up by British forces in Norway, the V4 was blown up by its own crew at Kiel-Holtenau, the V7 was destroyed by its crew at Travemünde, the C-011 and C-013 were captured intact by US forces and taken to the USA for evaluation, and the C-012, as previously recounted, was captured by British forces in Norway and flown to the UK. □



(Above right) The fourth BV 122 A-O airframe fitted with Jumo 207C Diesel engines as the BV 222 V7, the prototype for the C-series. (Below) One of the small number of C-series boats completed, showing the gun turret just inboard of the outer nacelle on the port wing.



The Falcon Family

Falcon 10: Scaled-down version of Falcon 20 with six-ten seats including pilots. Prototype with 2,950 lb st (1 340 kgp) CJ610 engines first flown 1 December 1970. Second prototype with 3,230 lb st (1 465 kgp) TFE 731-2 turbofans first flown 15 October 1971; first production aircraft flown 15 October 1972.
Falcon 20: Original Dassault biz-jet design (as Mystère XX) designed 1960/61, first metal cut February 1962, first flown 4 May 1963 (see separate listing of variants).
Falcon 30: Commuter-line development of Falcon 20 (at first as Falcon 20T, with smaller fuselage). Thirty passengers. Lycoming ALF 502D turbofan engines. Prototype first flown 11 May 1973; no production.
Falcon 40: Projected forty-passenger alternative to Falcon 30, using high-density seating and non-FAA certification procedures.
Falcon 50: Enlarged three-engined derivative of Falcon 20 with same basic fuselage, new wing and tail unit. Three 3,700 lb st (1 680 kgp) TFE 731-3 turbofans. Prototype first flown 7 November 1976 and, with fully-developed supercritical wing, on 6 May 1977. French certification obtained on 27 February 1979 and first production Falcon 50 flown on 2 March 1979.

GUARDIAN ——————————from page 179

name Gardian by Dassault-Breguet and differ from the Coast Guard's Guardian in several important respects in addition to the larger fuselage fuel tank.

Observation windows and ventral drop hatch are the same in both aircraft, but the Gardian's external stores provision comprises only four wing stations — two outboard stressed for 1,430 lb (650 kg) each and two inboard for 1,650 lb (750 kg) each. Avionics — at least for *Aéronavale* — are largely French, although the Collins FCS-80 autopilot is retained, and the ADS-80 air data system is a joint Collins-Crouzet product. The nose-mounted search radar is the Thomson-CSF Varan, and the remainder of the navaids and communications equipment include EAS VOR/ILS, SOCRAT VHF AM and ADF and TRT radio altimeter and UHF radio. Crouzet provides the navigation computer with area display. An Omera 35 oblique camera is fitted, and provision is made for CAI IR flash equipment to be carried. Like the HU-25A, the Gardian is powered by ATF3-6-2C engines to take advantage of the additional constant speed drive for a hydraulic motor to drive a 20 kVA alternator, but there is a further increase in gross weight, to a permissible maximum of 33,510 lb (15 200 kg).

The basic layout of the Gardian fuselage differs in detail from that of the HU-25A, and provides for an operational crew of six plus a four-seat couch. In addition to two pilots and two visual observers, the crew includes a navigator and a radar operator, seated side-by-side at the rear of the cabin and facing the main equipment consoles on the right-hand side. Without major difficulty, an additional four-seat couch can be fitted, to bring total occupancy to 14; alternatively, two stretchers can be carried in place of the two couches, or four VIP seats and removable tables can be fitted in the central cabin area, in all cases without removing the rear equipment consoles or the forward observation seats.

Programme

A number of airframes have been used by Dassault-Breguet, FJC and Garrett AiResearch in the development of the Falcon 20G, 20H and Guardian variants. On 28 November 1977, Falcon 20F No 362 was flown for the first time, at Bordeaux, in the guise of the Falcon 20G prototype, fitted with a pair of ATF3 engines (the first time these engines had flown). To increase the engine development flying, a Falcon 20C (No 137) was acquired by Garrett AiResearch in 1977 and first flew on 17 June 1978 after being fitted with an ATF3 on the starboard side only, retaining the standard CF700 to port.

In France, the manufacturers assigned Falcon 20F No 246 to the flight development of features of the new aircraft including the stall protection system for increased aft CG positions and then the Collins APS-80 autopilot and the new alternator. First flown in this programme on 1 April 1978, it retained the CF700 engines and later became known as the Falcon 20FH, after being fitted with the rear-fuselage tank and systems of the Falcon 20H, in which form it first flew on 24 April 1979. During 1978, deliveries of "green" Falcon 20 airframes to FJC began, for use in the Coast Guard programme; the original intention was to fly out 14 Falcon 20Fs for conversion at Little Rock, Arkansas, to have the later engines, with subsequent aircraft being fitted with ATF3s in France, but this plan has been varied by the delay in engine certification. In any case, FJC was and is responsible for installing the full suite of equipment in all 41 HU-25As, and has completed a number of these to date. The first example (No 371) destined to be fitted out to Coast Guard specification, but still powered by CF700 engines, was flown at Little Rock on 4 August 1978 with the extra fuel tank, and in subsequent development phases this aircraft was used to develop the ventral drop hatch and the new 20 kVA alternator before being fitted with ATF3s. Finally, on 30 April 1980, Dassault-Breguet flew a fully representative prototype of the Falcon 20H (given the serial No 401, but actually the original 20FH No 246); by the end of 1980 this aircraft had completed some 30 hours of testing.

Details of the original Falcon variants, up to the Falcon 20F, are separately summarised. To date, Dassault-Breguet has sold 465 examples of the Falcon 20 (including Guardians and Gardians) and production is continuing at the rate of 2½ a month, with a backlog of orders representing more than a year's production at that rate. Adding 197 Falcon 10s and 142 Falcon 50s brings the overall total of Falcon sales to 804, of which some 170 remain to be delivered. It is significant that 582 of these aircraft, or 72 per cent, have been sold in the Western hemisphere through Falcon Jet Corporation (in which, incidentally, Pan American has recently disposed of its half-share to Dassault-Breguet).

While the majority of Falcon 20s have been sold in the rôle of business transport for which the type was designed, 50 or so have already entered service in military or quasi-military guise, either as VIP and presidential transports, or in more specialised rôles such as electronic warfare training, radio calibration and research. To these assorted rôles will soon be added that of maritime surveillance and search-and-rescue, fulfilling the objectives set out by the US Coast Guard a full 10 years ago. □

The Falcon 20 Series

Prototype: First flown 4 May 1963 with Pratt & Whitney JT12A-8 turbojets. Re-engined with CF700 turbofans and first flown 10 July 1964.
Standard Falcon: The original production variant (also known as Falcon C) with 4,125 lb st (1 870 kgp) CF700-2C turbofans (-2D or -2D-2 later, by retrofit). Gross weight 26,450 lb (12 000 kg). First flown 1 January 1965; certificated 9 June 1965.
Falcon 20D: As Standard Falcon with 4,250 lb st (1 930 kgp) CF700-2D engines and increased fuel capacity. Higher gross weight: 27,337 lb (12 400 kg).
Falcon 20E: As Falcon 20D with 4,315 lb st (1 960 kgp) CF700-2D-2 engines. Higher gross weight: 28,660 lb (13 000 kg).
Falcon 20F: As Falcon 20E with leading-edge slats, improved trailing edge flaps, more fuel, improved electrical system and other changes. First flown May 1969, certificated (to FAR Part 36) on 20 January 1970.
Falcon 20G: Basic designation applied to Falcon 20F with Garrett AiResearch ATF3-6 turbofans and extra fuel in rear fuselage tank. Now applicable only to HU-25A Guardian variant for US Coast Guard. First flown 28 November 1977.
Falcon 20H: As Falcon 20F with 5,538 lb st (2 512 kgp) ATF3-6 turbofans, increased capacity rear fuselage fuel tanks and revised systems and equipment in common with Falcon 50. Gross weight 32,000 lb (14 515 kg). First flown 30 April 1980.

PERSONAL VIEW BY ROY BRAYBROOK

COME ON IN–IT'S MAGIC!

ILLUSTRATIONS BY CHRIS WREN

AVIATION
IS Magic!
Come on in!
Cw.

I RECALL arriving at Essendon Airport (which tells you it happened some time back, since Melbourne's Tullamarine celebrated its 10th anniversary last year) with just ten minutes in hand prior to lift-off. We had been out in the bush on a barbecue, hence the marginal timing on the departure for Canberra, but my friends assured me that 10 minutes was ample. *"This is Australia: no worries!"* In any event, the bloke from TAA took my bags without batting an eyelid, and the F.27 churned its way toward the capital with me inside it.

First stop was Albury, a town on the Murray River which separates the states of Victoria and New South Wales. The landing approach is generally one of the more interesting phases of a flight, and banking in low over this attractive township, its houses lit up by the setting sun, produced one of those picturesque moments that make up for all the nausea of travelling. A few passengers got off, and I watched a man with a barrow wheel away some suitcases.

And I looked at the barrow, and I thought the guy who owns that immaculate set of matched leather suitcases must be a gentleman of rare taste and distinction. A high-flyer, the kind of fellow who has travelled widely, first-class, probably with a smattering of half-a-dozen languages and an eye for a well-turned ankle. The kind of person one would be delighted to chat with over a glass of Glenfiddich and Perrier in the rooftop bar of the Vendôme in Beirut. Then I looked at the passengers who had disembarked, trying in vain to identify the owner of those fine suitcases, and the light finally dawned: they were mine!

Aside from learning to allow more than 10 minutes for check-in (even with wonderful people like those of TAA), and to watch carefully as the tags are attached to the baggage (Canberra is CBR, Albury is ABX), the reader has also been introduced to the name of Albury, which provides the link to this next beautifully-crafted vignette.

Among the many journals with which I am associated is the Australian magazine *Aircraft*. In earlier times — some 30 years ago to be more precise — the UK correspondent was one William Green, but in recent years standards have changed. The other night I was thumbing through the 1980 issues, and I came across Albury in a story concerning a Douglas DC-2, which (having served in its time with Eastern Airlines, Australian National Airlines, the RAAF, and Marshall Airways) was placed on display at the airport there in March of last year.

This DC-2 is now painted to represent the KLM aircraft (PH-AJU *Uiver*) which made an unscheduled landing on Albury racecourse during the 12,000-mile (19 200-km) London-Melbourne Air Race of 1934. It may be recalled that the outright winners of that event, with a time of 71 hours, were Scott and Black in a D.H. 88 Comet (G-ACSS *Grosvenor House*), which is now being restored to airworthy condition by the Shuttleworth Trust and will reportedly re-enact its historic flight on the golden anniversary of the race in October 1984. The practical significance of the D.H. 88 was in paving the way for the D.H. 98 Mosquito, and from an air transport viewpoint the more important aircraft was arguably the DC-2. This type was already operating a scheduled service between Amsterdam and Djakarta (then capital of the Dutch East Indies), and KLM was campaigning for permission to extend the service to Australia. For the airline this race (which honoured the Melbourne centenary and was sponsored by Sir Macpherson Robertson, the Melbourne chocolate tycoon) represented an ideal opportunity to demonstrate the potential of this high speed, cantilever-wing monoplane with its cleanly cowled radial engines, variable-pitch propellers and semi-retractable undercarriage.

All went well for the DC-2 until the final leg from Charleville (Queensland) to Melbourne. It was a night flight, and the aircraft ran into severe electrical storms, which wiped out radio contact and blew it off course. It ended up flying circles around the Canberra area, with the crew trying to fix its position. They might have terminated their flight in a cloud full of rock, had it not been for the fact that a local radio station appealed for motorists to take their cars to Albury racecourse to provide a makeshift flarepath (700 vehicles turned up), and the town's power station flashed the lights over the whole area in the Morse signal "Albury". The DC-2 landed safely, but bogged down. However, next day it was hauled to firmer ground by 300 local residents, and it flew on to Melbourne to take first place in the handicap section and second place overall.

I have no way of knowing whether this epic happening at Albury really saved the day (or rather the night) for KLM's crew in the DC-2. The only thing that is known for sure is that the entire population of a town was suddenly involved in an aviation incident to an extent that would be virtually unthinkable today. Imagine, if you will, the public reaction to every TV set in town switching on and off as the chief electrical engineer spells out H-U-D-D-E-R-S-F-I-E-L-D with the street lights to some 747 circling nervously over the Pennines!

For me, the story of the DC-2 at Albury epitomises the public image that aeroplanes and flying must have had in the 1930s. Aviation was new, it fired the imagination, it was changing the world! For the majority, the excitement has now gone, and aviation is widely portrayed as a dull routine, worthy of general media coverage only when lives are lost or millions are spent.

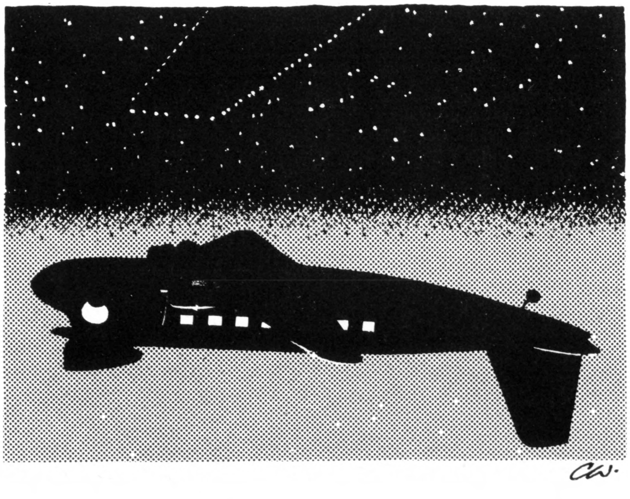
It is, of course, quite right that air transport should now be regarded as a perfectly routine matter. Some older Boeing 707s have clocked over 60,000 flying hours, covering distances of the order of 30 million statute miles (48 million km), or the equivalent of 60 return journeys to the moon! The bald statistics may be difficult to comprehend: the sheer reliability of the modern transport aircraft is probably most striking when you see such a machine being operated on a round-the-world service, such as BOAC, Qantas and PanAm provided over 10 years ago.

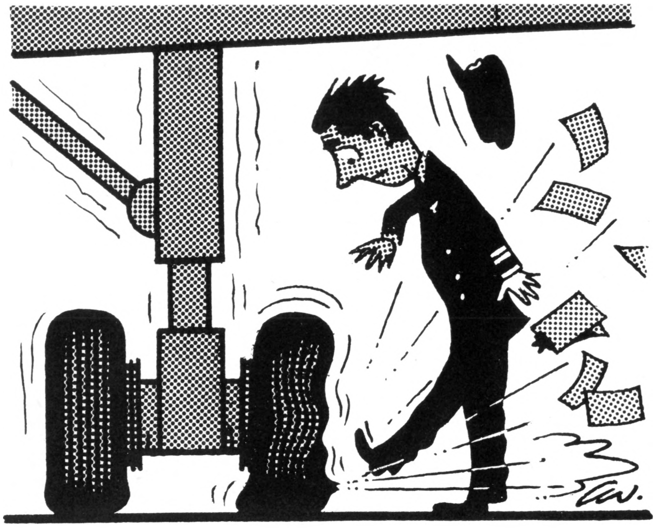
When I flew to Australia in the late 1960s it was preferable to travel westabout to avoid the risk of hijackings in the Middle East. In those days you could fly from London to Sydney in a BOAC 707 that went via New York, San Francisco, Honolulu and Fiji. This fourth stop was made in the middle of the night, with just over 28 hours elapsed and approximately 25 hours flying time from Heathrow. You had about 40 minutes on the ground at Nandi (time for a quick shower, if you knew your way around) before going back to the iron bird. The driver would press the starter button one more time, the Rolls-Royce Conways turned as they invariably turned, and just over four hours later you were on the ground at Sydney, having covered a grand total of 13,600 st ml (21 760 km) in 33 hr elapsed and 29 hr 10 min flying time.

The sheer dependability of that operation never failed to impress me. They would simply put it on the ground, remove the bodies, fill up the tanks, restock the galleys, put the bodies back in, kick the tyres, light the fires, and head out over another long stretch of ocean. Only 40 years previously (in 1928) Kingsford Smith and Ulm in their Fokker F VII-3m *Southern Cross* had made the very first aerial crossing of the Pacific from the US to Australia, with a flying time of 83 hr 11 min between Oakland, Calif, and Eagle Farm, Brisbane. As for most of the scheduled flights that followed, they refuelled at Honolulu and Fiji.

Military aviation will never become as routine as its civil transport counterpart, but it too is far safer than it was. The latest ejection seats can save the pilot from some apparently fatal situations, and within the foreseeable future there will be vertical-sensing seats that will extend the survival envelope even further. The jet fighter has come a long way from the days of the Me 163 Komet, in which (even if the remaining rocket fuel did not explode) a skid landing almost routinely produced spinal injuries, and the Gloster Meteor, in which practice single-engine landings killed far more pilots than did engine failures.

However, just because it is now far safer and more routine, aviation is no less wonderful than it was in the 1930s. The difference is that in those days the novelty, the pace of advance, and the effects of aviation in linking continents and introducing new types of warfare were obvious for all to see. Nowadays, the wonder is apparent only to those who have some knowledge of what goes into making an aircraft function, and how that aircraft relates to what went before and what will come in the future.





Since this column is read only by people who are interested in aviation and by a handful of PR managers who fear I may destroy the companies they represent, it might be said that I am preaching to the converted. However, the real point is that unless those of us who work in aviation can convey its special magic to those on the outside (and especially the young), then as aviation becomes more and more routine the industry will increasingly fail to attract the very people that it needs to ensure a healthy future.

At the time of writing, the widespread recession and unemployment problems affecting many of the industrialised nations may have produced a situation in which the supply of personnel vastly exceeds the demand. However, the next few years will probably see a return to a more normal situation in which aviation has to compete with other industries. Unless we can make a start now in giving the aviation business the public image it deserves, and thus recruit the right people at an early age, then the industry will continue with the present ludicrous situation in which, all too often, its leaders have to be appointed from other professions, such as the oil industry, the universities and the civil service.

What sparked off this line of thought was that a few weeks ago I received a fan letter (50,000 readers fall off their chairs in disbelief) from a young man, aged 15 and living in Wakefield. Aside from the fact that this was only my second fan letter in 20 years of writing, it struck a special chord in that he happens to live not far from the place where I spent my first 18 years.

Now I have no knowledge as to whether my young correspondent has any interest in aviation as a possible future profession; but I do know what it is like to be a young aviation enthusiast in a place such as Wakefield. You do not cycle down to the Green Man with your Zenith and 135 mm and snap 747s coming through the trees to land at Wakefield Intercontinental Airport. Your breakfasts are not enlivened by B-52s smoking skywards out of Wakefield AFB. There is no Wakefield Aerospace Museum and no biennial Wakefield International Air Show. You can turn up your VHF until the transistors melt, and all you will hear is static.

The place where I was born does actually have an airstrip, a place that we used to know as David Brown's Airfield, and is officially listed as Crosland Moor. It was (and still is) a grass strip up in the hills on the other side of town, with a public footpath straight across the middle of the runway. In my youth I would trek up there to see the occasional Auster, Proctor, and Messenger. The nearest airfield of any size was Yeadon (now Leeds/Bradford), where there was an Auxiliary Spitfire squadron. To see transport aircraft (aside from the regular DC-3 overflying *en route* for Scotland) meant an expedition to Manchester-Ringway, where I actually encountered other spotters for the first time. Luckily for me, I had an uncle in the ATC, who took me round RAF airfields in his car. I recall the excitement of seeing the first B-29s at Scampton (I think), with colourful markings, armed guards and dogs. Most un-English.

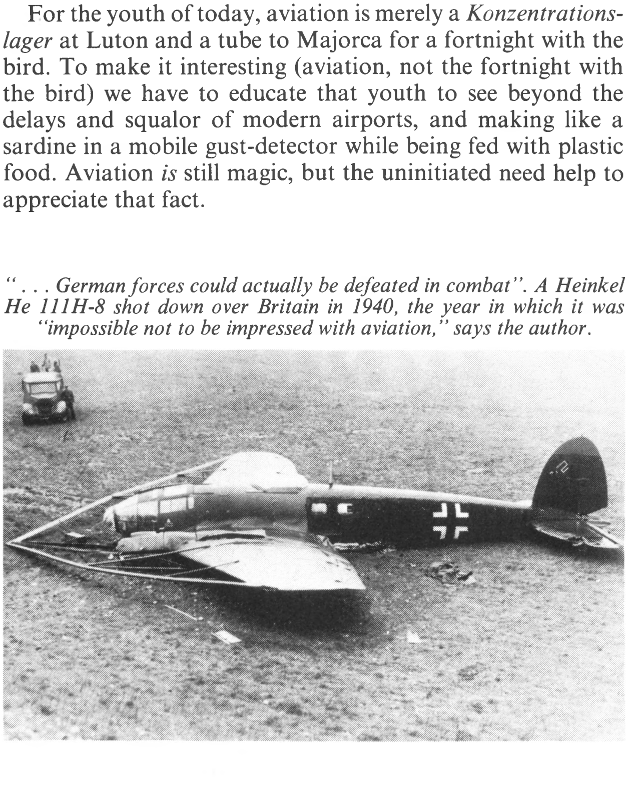
The fact that my interest persisted to the point that, having completed my education, I actually scratched a living in aviation might be attributed in part to my uncle's encouragement. However, in any general comparison with today's youth, the big difference is that my own generation simply had far more reason to be interested in aircraft. Having lived through the war, we had automatically been brainwashed with the importance of aviation.

For anyone who was not around in 1939-40, it must be difficult to imagine how significant the Battle of Britain was at the time. Nowadays, if you talk with men who served on the German side, they will tell you that at times Hitler's *Wehrmacht* would have made "Dad's Army" seem like the Coldstream Guards; but until August 1940, all the external evidence pointed to the fact that Germany was completely invincible. The fact that German forces could actually be defeated in combat was a staggering piece of news that put a different complexion on the whole business.

It is fashionable now to say that the published kill ratios were hopelessly wrong, that the *Luftwaffe* was not defeated, and that the Battle of Britain was not the reason why Hitler did not proceed to cross the Channel. Whether or not these arguments are correct is academic. The *fact* is that the Battle gave the people of Britain an enormous morale boost at a time when it was desperately badly needed, and introduced in their minds a completely different perception of the country's future prospects. Suddenly it was just another war, which Britain would muddle through and win in the long run, as the country always had done. For those who were young at the time, it was impossible not to be impressed with aviation: it changed everything!

For the youth of today, aviation is merely a *Konzentrationslager* at Luton and a tube to Majorca for a fortnight with the bird. To make it interesting (aviation, not the fortnight with the bird) we have to educate that youth to see beyond the delays and squalor of modern airports, and making like a sardine in a mobile gust-detector while being fed with plastic food. Aviation *is* still magic, but the uninitiated need help to appreciate that fact.

". . . German forces could actually be defeated in combat". A Heinkel He 111H-8 shot down over Britain in 1940, the year in which it was "impossible not to be impressed with aviation," says the author.



In my view there are two main aspects to encouraging people to take an interest in aviation; allowing them to see aircraft in reasonably close proximity, and providing background education. At most military airfields it should be possible to have proper facilities for the public to "Come And See Your Air Force" (or Fleet Air Arm, or whatever) any day of the year. I cannot believe that this would have any effect on security: most UK air activity is already covered in penetrating detail in spotters' magazines, and the KGB presumably does slightly better in those areas that really matter.

Likewise, the general aviation community should appreciate that it is in their own long-term interest to provide facilities for the general public to view their aircraft, if only to offset the community noise problem of 1930s-technology powerplants. In this respect, Doug Arnold's airfield at Blackbushe is a shining example: a well-sited and properly-fenced public area with free car park and, invariably, something worthy of note on the ramp. If there is any justice in the world, Blackbushe will survive long after airfields such as Elstree, Fairoaks and Redhill have become housing estates.

Turning to the matter of providing a background education on aviation, the most glaring deficiency in the UK is in regard to the use of TV. The standard yearly ration of aviation on the tube amounts to a couple of summaries of local air shows (Paris is virtually ignored) and endless re-runs of war movies ("You die, Yankee dog!") that should have been junked 40 years ago. What makes this all the more ridiculous is that every worthless, sterile hobby known to man has its own regular prime-time spot, while those thousands of fine young people who flock to air displays with their Praktikas and VHF radios are completely ignored by the so-called "planners" who provide this expensive TV service.

The fact that TV is an ideal medium for conveying the magic of aviation has been demonstrated by Julian Pettifer's series for BBC, "Diamonds In The Sky", which was transmitted in 1980 and was worth seeing for the shots of air operations in Papua New Guinea alone. If TV can make an intrinsically snore-worthy thing such as air transport *look* interesting, then imagine what it can do for combat aircraft! In all seriousness, if you see an F-104 or an F-16 on the ground, it looks like a very reasonable piece of aluminium; not quite up to RB standards of elegance, but not a pain in the eye, either. However, if you see such a fighter by means of ciné film, taken close-up air-to-air, then it is like the young Elizabeth Taylor, your first taste of Cointreau, and learning that your wife wants to go on working, all rolled into one.

There is clearly plenty of film in the archives to make an interesting feature series on the history of the fighter. As for present-day equipment, there is (to give just one example) an outstanding new air-to-air film of the Red Arrows, which should be compulsory viewing for all young people; and there is a great deal of good material in sales films which are never seen by the general public. Harrier films are particularly dramatic, even if you do know that the tank "strikes" are actually stolen from Swingfire ground-to-ground missile trials.

Provided that the aircraft manufacturers and civil and military operators support the making of such TV programmes, then aviation may win back something of the ground that it has lost in the public eye, and the future of the business will hopefully be strengthened by being able to recruit the right people.

What advice can one give to a young person considering aviation as a career? Frankly, although few people get rich in aviation, most of us in the business feel that the sheer interest of the job has a certain intrinsic value. Some employers may have banked too heavily on this interest in the past, but the industry is gradually getting straightened out, and salaries (even in the UK) aren't really that bad. Hence, if you feel that you just wouldn't be happy doing anything else, give aviation a try. You might just find that it's magic! ☐

That Lemming Syndrome

JUST as those little arctic rodents, the lemmings, are remarkable for their annual migrations to the sea, so has the plastic model kit industry displayed over the years a remarkable lemming-like follow-my-leader propensity towards duplication, triplication and even quadruplication of subject matter. This desire on the part of kit manufacturers to emulate each other insofar as is concerned the aircraft types to which they devote their ever-more-expensive polystyrene has for long aroused ire within the modelling community. Competition is a good thing, but there are limits. It was to be expected that there would be a repletion of kits of WWII's immortals; what kit producer can possibly stand by and allow its competitors to corner the market in such hardy perennial money-spinners as the Messerschmitt Bf 109, the P-51 Mustang or the Spitfire. These are the stuff of which legends are made; the types that the schoolboy almost invariably selects for cutting his teeth in our pastime.

The multiplication of kits of these most popular of subjects has, over the years, generally led to the availability of more accurate and more detailed offerings, although it has by no means always culminated in a virtually *definitive* kit. Oddly enough, it has often proved to be more difficult to attain that highly desirable stage with the best documented types. The proliferation of drawings and data published of, say, the Bf 109, has served to confuse kit designers; many and varied are the drawings of the Messerschmitt fighter claiming total authenticity because they are based on "*original* works drawings", but such "works drawings" would seem to have been extraordinarily profligate and remarkable for their divergencies in basic outline let alone detail.

Accepting that there have been good reasons for multiplication of available kits of the *popular* WWII types, it does not follow that similar multiplication of other types is desirable from the modeller's viewpoint or even commercially practical insofar as the manufacturer is concerned. Take, for example, the latest US contenders in the fighter stakes, the F-16 Fighting Falcon and the F-18 Hornet. The latter has achieved a truly extraordinary score of kits and is yet some considerable time away from full service status, while the former is snapping at the heels of its aesthetically more appealing contemporary with a kit score that is steadily mounting. With several kits, all of acceptable standard and of similar scale, of one aircraft type vieing with each other in a market that is suffering badly from the effects of inflation, there can be little joy for the individual manufacturers when they see their sales returns.

It is yet sadder to see duplication of the somewhat more exotic — but highly desirable — types, such as the Curtiss SBC-4 Helldiver, of which a kit from Lesney is reviewed in this column this month. We have little doubt that the production of a kit of the Curtiss biplane in the same sub-type and to the same scale as that recently presented by Heller is pure coincidence, but what a pity is such duplication, for both kits have so much to commend them yet they must share what is inevitably a relatively limited market, possibly discouraging further ventures in an area in which so much remains to be done.

Even with vac-forms we have instances of duplication of effort, the most glaring example — which was, in fact, a case of *triplication* — being provided by the Vulcan. After seemingly endless years of waiting for a 1/72nd scale kit of this handsome bomber, Rareplane, Forma-Plane and Nova Models produced kits virtually simultaneously! The first injection-moulded Vulcan kit in 1/72nd scale is still awaited, but we believe that it will not be too long before such makes its appearance. Will we then find that we have *two* injection-moulded kits of the Vulcan from which to choose and no kit of the Victor; the latter has never appeared even as a vac-form.

We modellers would never like to be thought ungrateful for what we are offered by the kit manufacturing industry, but in these days of recession and inflation, with falling sales as an inevitable consequence, are we being so naïve if we ask, in view of the situation facing the industry, if it would be commercially totally impracticable for kit producers to co-operate with each other in their choice of subject matter? Such would obviously call for some hard bargaining and reasonable give and take, but it would reduce the possibility of duplication with obvious sales benefits.

This month's colour subject

The long-nosed Focke-Wulf Fw 190D has never commanded the same following among modellers as its more proliferous radial-engined brethren, although this very formidable version of Kurt Tank's superb fighter saw considerable operational use in the final phases of the conflict in Europe, restoring for a brief period the combat performance of the *Jagdflieger* equipped with *Dora* to at least parity with Allied units flying the most recently committed types.

The *Langnasen-Dora* or *Dora-9*, as the Fw 190D-9 was dubbed with its arrival in the ranks of the *Jagdgruppen*, began to roll off Focke-Wulf's Cottbus assembly line in quantity in August 1944, and the pilots of *III Gruppe* of *Jagdgeschwader* 54, which was the first unit to fully equip with the fighter on which it achieved operational status during October, were convinced that the *Langnasen-Dora* was more than a match for the much-vaunted P-51D Mustang. Even though some 30 per cent of all Fw 190 production facilities had been overrun by Soviet forces, the conversion of units to the Fw 190D-9 continued into the last weeks of the conflict. A substantial proportion of the newly-delivered fighters were to sit out their brief service careers with empty tanks, however, and a substantial number were captured by the advancing Soviet forces. For example, in the spring of 1945, at least one *eskadril* of an IAP of the Red Banner Baltic Fleet Air Force flew Fw 190D-9s that had been captured at Marienburg in East Prussia (now Malbork, Poland).

The *Langnasen-Dora* has received a fair share of attention from the kit manufacturers, and kits of the Fw 190D-9 have appeared in a reasonable selection of scales. The largest of these kits is Revell's 1/32nd offering, which, if quite acceptable, is by no means definitive. Such limitations that it embodies are not too serious and it builds up into a relatively well-detailed model reflecting the general state of the kit manufacturing art of a decade ago. Fujimi has a kit which is allegedly to 1/48th scale, although it is actually nearer to 1/50th. This looks quite well when made up, but suffers outline inaccuracies and is certainly not to be numbered among Fujimi's best efforts, leaving room for a good new kit in 1/48th scale. Insofar as 1/72nd scale is concerned, Airfix has taken two bites of the cherry, and its later version is, in our opinion, the most recommendable, sharing top billing with another good version from Hasegawa. Still another kit of the *Langnasen-Dora* in this scale exists, but this, by Lindberg, is very old and does not really make the running.

Last of the two-decker heavies.

Noteworthy in RAF annals as the last of its biplane heavy bombers, the Handley Page Heyford was an odd-looking creation, with fuselage suspended from upper rather than surmounting lower wing, and an immense undercarriage with mighty bulbous spats. Apart from one squadron of Hendons and a few obsolete Virginias, the Heyford provided the equipment of the RAF heavy bomber force for several years until the RAF Expansion Scheme got into its stride. First entering service in November 1933 with No 99 Sqdn at, appropriately enough, Upper Heyford. The Heyford finally departed first-line service in 1939, but continued on various training duties until finally declared obsolete in July 1941.

The history of the Heyford as a model kit goes right back to its own heyday when a hardwood kit was included in the famous *Skybirds* range designed by the late James Hay Stevens and generally accepted as the true pioneers of 1/72nd scale. Over the intervening two-and-a-quarter score years we have had a vac-form from Contrail, but now Lesney, with its commendably adventurous spirit, has produced a 1/72nd scale "Matchbox" injection-moulded kit.

With a total of 146 component parts moulded in two shades of dark green, black and clear plastic, this is a nicely detailed kit which brings out very well the unique appearance of the full-scale aeroplane. For the most part, the covering of the Heyford airframe was fabric, and this is well simulated by this kit, while the external stiffening of the monocoque forward fuselage and the lower wing centre section is nicely represented. So too are the panel lines, such as those on the engine nacelles. The retractable ventral turret, or "dustbin", is extended and, while not retractable, is rotatable and is complete with gun and mounting. The wide, open double cockpit would benefit from the addition of detail, but if the crew figures are used the effect is acceptable enough. The two control quadrants were, in fact, attached to a tubular arch which pivoted near the floor and not, as in the kit, mounted on the instrument panel. The nose and dorsal gun positions of the Heyford were equipped with Scarff mountings for their 0·303-in (7,7-mm) Lewis or Vickers guns, and the kit includes the guns but *not* the mountings.

Provision is made for building any one of the three versions of the Heyford, the Mks I, II and III. The visible differences are primarily in detail, but the "Matchbox" kit caters for these, including such items as alternative wheel pants, three- and four-bladed propellers, and varying radiator intake designs. The main bomb load was housed in the thickened centre section of the lower wing, and the kit allows for the bomb bays to be left either open or closed by recourse to alternative bottom panels, one of which has open doors so that the bombs can be seen. Additional bombs were carried on external racks, and these are included in the kit, together with a selection of high explosive and incendiary bombs of various sizes, together with the appropriate carriers. These stores account for almost one-third of the total parts of the kit.

There are some nice detail touches, such as the clear porthole windows in the forward fuselage, the propeller guards and handrail behind the pilot's cockpit, and the wind-driven generators in the wing leading edge. The accompanying instruction sheet is excellent, with very clear assembly diagrams and painting instructions, and there is a fine decal sheet with markings for three different machines: a Mk I of No 99(B) Sqdn, a Mk II of No 7(B) Sqdn, and a Mk III of No 102(B) Sqdn. Although in its later years the Heyford sported the so-called "shadow shaded" disruptive camouflage, and even, while on training tasks, yellow undersurfaces, the only typical finish is overall nivo green, a difficult shade to achieve but closely represented by Humbrol No 75 Bronze Green. With its single-bay wing arrangement, the Heyford did not have an excessive amount of external wire bracing, and, for so large a biplane, makes a quite easily constructed model.

A 'twenties Fokker

The adaptability and versatility of some of the 'tween-wars aircraft was quite remarkable and that of the Fokker C V almost legendary. The C V series, which saw birth in 1924, was to prove amenable to a vast array of different engines ranging in output from 250 to 730 hp, it was to have no fewer than five different sets of wings during a production life spanning a decade, and it was to serve with a dozen or more air forces, participating in insurrections, revolutions and full-scale wars. If spotters existed in those far off days, the Fokker C V must surely have given them nightmares.

A 1/72nd scale vacuum-formed kit for this exotic subject has been produced by a newcomer to the scene, a Swedish concern known rather whimsically as "Trucker's Mate"! It would seem that this unusual appellation stems from the fact that the kit's designer is a trucker whose hobby is plastic aircraft modelling, this being his first venture into the kit production field. This vac-form kit certainly provides the basis for an intriguing little model. It consists of 19 component parts comprising wings, fuselage and tail surfaces moulded in one sheet of white plastic. The moulding is not to the highest modern standards, but is certainly acceptable. It presents a good rib effect on the flying surfaces, although we feel that the stringers along the fuselage sides have been exaggerated. None of the smaller parts are provided.

This kit depicts the C VE of 1926 with the large span (50·2 ft/15,3 m) wings and a 450 hp Bristol Jupiter radial engine as supplied to Sweden's *Flygvapen*. Finding a suitable engine and propeller presents no problems if you have access to an Airfix Bristol Bulldog kit, and other components may be obtained from the same source. There are no decals, but a nice three-view general arrangement drawing is provided, with notes on the colour scheme and markings in English. At present, this kit, which we hope may be the first of a series covering types which have served with *Flygvapnet*, is obtainable only direct from the designer, Sten Andersson, Mariebergsrägen 33, 61100 Nyköping, Sweden, the price being SwKrona 25, plus postage.

Uncle Sam's last combat biplane

When we first heard of the intention of both Heller and Lesney to produce 1/72nd scale kits of the Curtiss SBC Helldiver biplane, we had a fleeting hope that one would opt for the SBC-3 and the other SBC-4, but it was really to be expected that both would go for the later version, the French company being influenced by the fact that this was the variant ordered for the *Aéronavale* and the British company by the fact that the few that flew briefly in the UK as Clevelands were SBC-4s (and, in fact, French contract aircraft). Heller's offering reached the market first, and if the new "Matchbox" kit had the field to itself, we would welcome it wholeheartedly, for it is a fine product. As it is, we can only decry the fact that *two* leading kit manufacturers should have each spent so much time and effort producing kits of the selfsame type in the same scale and of closely comparable quality.

The "Matchbox" SBC-4 kit comprises 48 parts beautifully moulded in light grey, yellow and clear plastic, with neat surface detailing — there are a few rather deep lines on the forward fuselage but the rest are fine — and good, if marginally exaggerated, representation of the rib effect on the lower wings, elevators and ailerons. We particularly like the finely-formed undercarriage, which may be assembled in extended or retracted position as desired, and the cockpit interior, which has its limitations, is acceptable if the two accompanying crew figures are utilised. The clear canopy is in four separate sections, facilitating omission of the rear section if the free-mounted gun is fitted — in this case, the top rear fairing is also omitted so as to appear as if lowered.

The Cyclone engine is represented in half-relief and looks well after painting, its single row of nine cylinders being well enclosed by its cowling. The two exhausts are formed separately. The upper wing is formed tip-to-tip in upper and lower panels, while the lower wing is made as one-piece mouldings for each half. Assembly of the biplanes is facilitated by the sub-assembly of the centre-section struts with the upper forward fuselage panel giving positive location together with the single broad interplane struts, the whole forming an effective jig. Small details include the arrester hook, footholds in the fuselage, a gunsight for the pilot's fixed forward-firing Colt-Browning, and a clear lens for the landing light in the leading edge of the lower port wing.

The decal sheet is not very large, but it is of good quality, colour and register, offering markings for the Air Group Commander's aircraft aboard the USS *Enterprise* in 1940, and a camouflaged Cleveland I of No 24 Sqdn, RAF, which briefly had three machines of this type on strength at Hendon in 1940. This kit is included in the Purple range.

A vac-form for a vac-form

The idea of a vac-form conversion kit for a vac-form kit is, to say the least, novel, but Formaplane has produced just such and it would seem to be an extremely good idea. Formaplane has had in its range a 1/72nd scale kit of the Royal Aircraft Factory's B.E.2c reconnaissance biplane for some time, and this conversion kit caters for a number of variations on the basic design, including an earlier B.E.2c with a twin-skid undercarriage, the B.E.2d, the B.E.2e, the B.E.2f, the B.E.12 and the B.E.12Ae. The parts, of which there are 35, are impressed upon a single sheet of white plastic, and include new upper and lower wings, tailplane and nose sections, the flying surfaces being single-surfaces as in the basic kit.

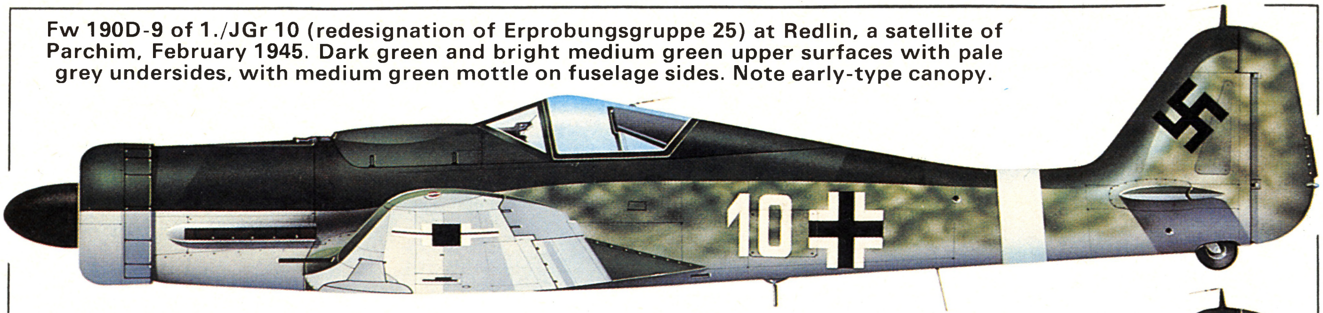
In conjunction with the alternative nose, representing modifications to accommodate the 150 hp Hispano-Suiza engine fitted to some later models, cylinder blocks and exhaust pipes of different shapes are provided, while the new wings enable the modeller to produce the single-bay variants with short-span lower and extended-span upper planes. Among the smaller components included are a wing-mounted fuel tank, and Lewis and Vickers machine guns. The impressions of struts on the plastic sheet are intended to serve as templates for cutting the components to size rather than for direct use. It should be emphasised that this is a conversion kit to be used in conjunction with the original kit to produce any one of the several types previously mentioned. The quality and clarity of the mouldings are first rate, and we were well impressed with the fineness of the surface detailing which puts many a recent injection-moulded kit to shame. The general arrangement and assembly drawings are excellent, and a double-sided sheet of instructions gives information on the conversions and appends a list of references, this being a very useful feature. Our sample kit came from BMW Models which can supply the conversion kit at £1·25, or in conjunction with the basic B.E.2c kit at £2·10, plus 75p postage in each case. No decals are included in these kits. □

F J HENDERSON

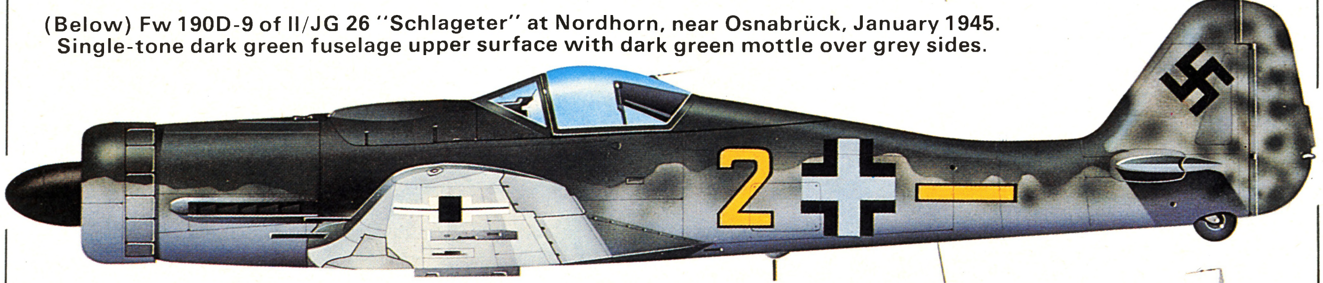
Remember please ...

The editors of AIR INTERNATIONAL are unable to enter into personal correspondence with readers, and specific requests for information about individual aircraft, etc, cannot be answered by post. Letters of a more general nature requiring an answer MUST be accompanied by return postage (stamps or IRC).

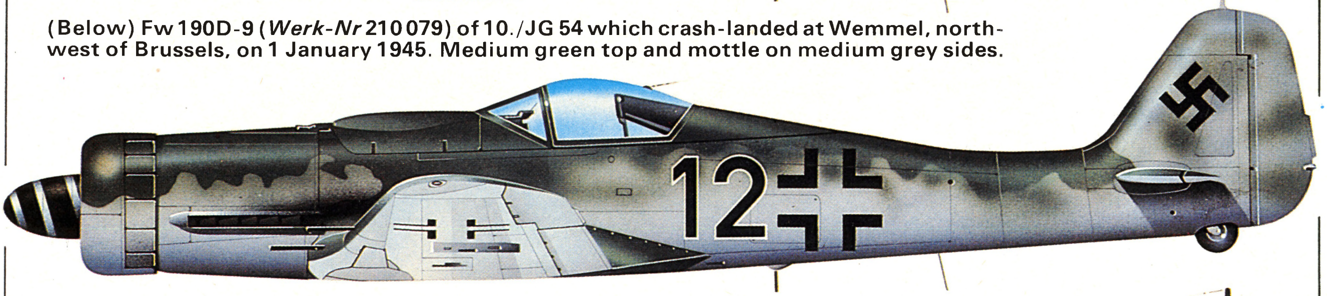
Fw 190D-9 of 1./JGr 10 (redesignation of Erprobungsgruppe 25) at Redlin, a satellite of Parchim, February 1945. Dark green and bright medium green upper surfaces with pale grey undersides, with medium green mottle on fuselage sides. Note early-type canopy.



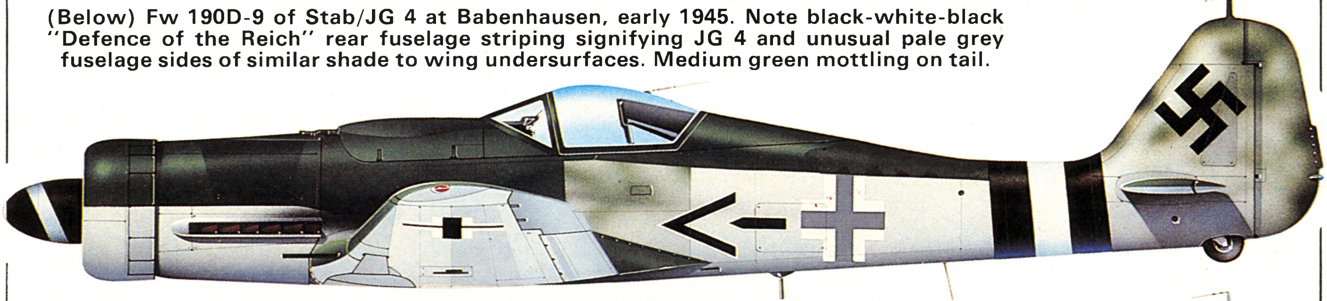
(Below) Fw 190D-9 of II/JG 26 "Schlageter" at Nordhorn, near Osnabrück, January 1945. Single-tone dark green fuselage upper surface with dark green mottle over grey sides.



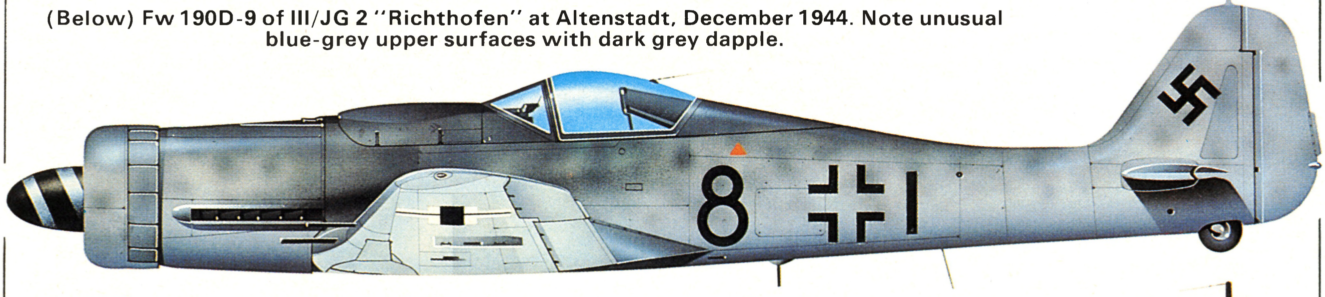
(Below) Fw 190D-9 (*Werk-Nr* 210 079) of 10./JG 54 which crash-landed at Wemmel, north-west of Brussels, on 1 January 1945. Medium green top and mottle on medium grey sides.



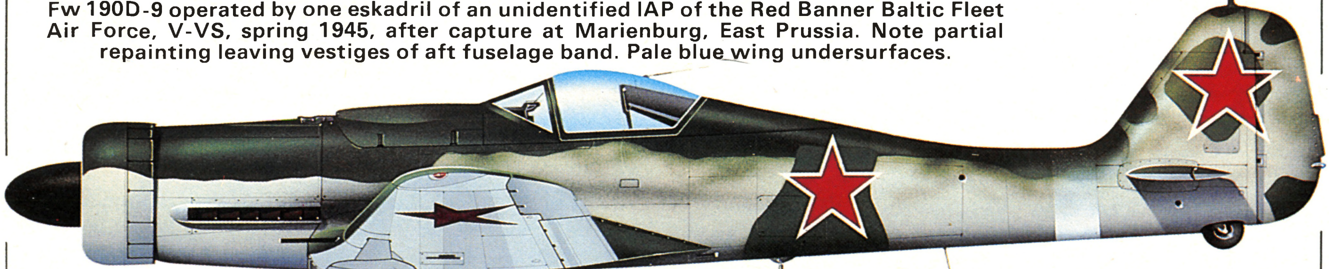
(Below) Fw 190D-9 of Stab/JG 4 at Babenhausen, early 1945. Note black-white-black "Defence of the Reich" rear fuselage striping signifying JG 4 and unusual pale grey fuselage sides of similar shade to wing undersurfaces. Medium green mottling on tail.

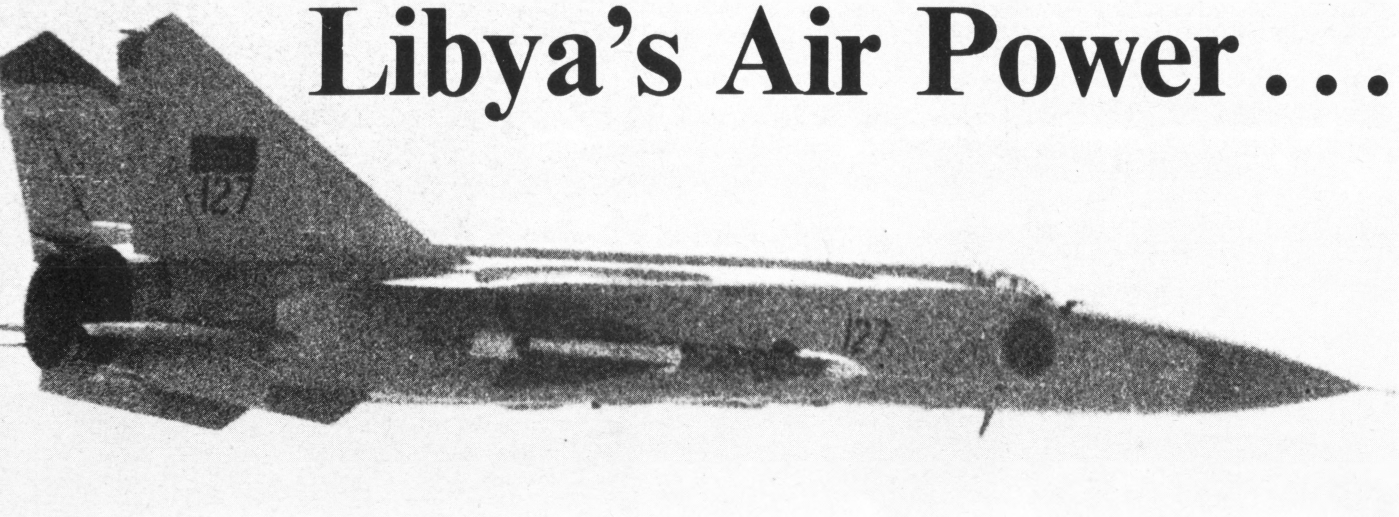


(Below) Fw 190D-9 of III/JG 2 "Richthofen" at Altenstadt, December 1944. Note unusual blue-grey upper surfaces with dark grey dapple.



Fw 190D-9 operated by one eskadril of an unidentified IAP of the Red Banner Baltic Fleet Air Force, V-VS, spring 1945, after capture at Marienburg, East Prussia. Note partial repainting leaving vestiges of aft fuselage band. Pale blue wing undersurfaces.





Libya's Air Power . . .

. . . National Aspiration and Soviet Surrogation

THE MISSILE-TOTING MiG-25 *Foxbat-A* suddenly appearing off the wingtip of an MEA Boeing 720 *en route* from Beirut to Rome; the MiG-23 *Flogger-E* buzzing a US Navy 6th Fleet auxiliary in Mediterranean international waters; the pair of Mirage F1EDs on combat patrol within the fringes of Egyptian airspace; the Aero L 39ZO Albatros loosing its 57-mm S-5 rockets over the weapons range near Zawia and the Hercules transport landing at N'djamena in Chad. All display the Islamic green disc of the so-called Socialist Popular Libyan Arab State, but the chances are that their pilots and the groundcrews maintaining them are as disparate in nationality as the aircraft in origin.

The aircraft that are today included, at least nominally, in the inventory of the Libyan Arab Republic Air Force (LARAF) are legion, both in type and quantity. They embrace virtually every first-line combat aircraft type represented in the Soviet Union's *Frontovaya Aviatsiya*, from the latest *Fitter-H* version of the Su-20 interdictor to the *Hind-D* gunship version of the Mi-24 helicopter; a variety of Mirage strike fighters and interceptors, both delta- and swept-winged; primary, basic and advanced training aircraft of Italian, Yugoslav and Czechoslovak manufacture, and a sizeable fleet of French, Soviet and Italian-built US helicopters.

At the immense Okba Ben Nafi air base complex, originally built by the US government as Wheelus Field; at the Air Force Academy at Zawia; at such bases as El Adem, Benina and Al Kufra, the language to be heard is as likely to be Russian or Urdu, German or Serbian, as Arabic. This large and ever-growing cosmopolitan arsenal of sophisticated aeronautical hardware, financed by vast oil revenues, far outstrips Libya's ability to provide indigenous air or ground crews, now or in the foreseeable future, if, indeed, such has ever been the aim of the erratic and volatile Colonel Mu'ammar Kadhafi, who ostensibly controls LARAF, together with the other Libyan armed forces.

Libya has the highest *per capita* armament expenditure of *any* of the world's nations. In terms of numbers of aircraft, LARAF is now — on paper at least — challenging for third place among air forces in the Middle East and North Africa those of Iraq and Syria, with a personnel strength appreciably less than one-tenth of either! In fact, LARAF currently possesses less than 3,500 personnel, of which, if semi-official Cairo sources are to be given credence, fewer than 100 are combat-qualified pilots. Indigenous personnel at flying and technical levels are far outnumbered by personnel seconded from the Soviet and Pakistan air forces, East Germans, Yugoslavs, Palestinians, and, on occasion, Cubans and North Koreans. These expatriates are largely responsible for flying and almost entirely for servicing and maintaining the 300 plus combat aircraft and the more than 350 support and training aircraft now occupying Libyan airfields.

There is evidence to support the contention of those same Cairo sources that, in practice if not in principle, there are not one but two air forces in Libya. One might be termed the *genuine* LARAF, with the aid of which Colonel Kadhafi presumably hopes to further his dream of a vast "Saharan Islamic Republic"; the other, avowedly under Libyan but in reality under rigid Soviet control, is part of the LARAF in token only and its primary task is the defence of the Soviet Union's heavy investment in this, its most important African client state. The latter force provides support for Libyan activities when such are planned in Moscow or considered to be in Soviet interests, however, for Libya, acting as a destabilising influence in the region, is giving the Soviet Union new points of leverage and has assumed a valuable surrogate rôle in its relations with terrorist groups and "national liberation" movements.

Libya today accommodates some of the biggest forward depots for Soviet weapons stockpiles presumably for use in any future Middle East conflict, and in defence of these depots and other installations, the Soviet Union has supplied some of its most efficacious and modern combat aircraft, which, nominally owned by Libya, are factually under total Soviet control. Manned and maintained by V-VS personnel, allegedly on secondment to the LARAF in advisory and instructional capacities, these aircraft display LARAF insignia, but their operations are ordered from Moscow and *not* from the Air Force Headquarters in Tripoli. For example, the support of Libyan forces engaged in neighbouring Chad last year by the V-VS-manned Tupolev *Blinder-A* bomber squadron based at Okba Ben Nafi was possible only as a result of permission being granted by Moscow, as was also the use of Mi-24 *Hind-D* gunships.

Despite Libyan denials of involvement in Chad, the 4,000 troops manning the two infantry divisions of Kadhafi's "Pan-African Legion", plus artillery, armoured units and air cover, proved a decisive factor in the successful outcome for puppet President Queddei in his war against the factions led by Defence Minister Hissene Habre. LARAF aircraft were first employed in the Chad conflict on 9 October, when *Blinders* bombed the positions of forces loyal to Hissene Habre in the stricken capital, N'djamena, and its adjacent airfield. Further attacks on N'djamena and other towns were mounted over the following weeks by *Blinders* and LARAF Mirages*, and *Hind-D* gunships saw extensive use in support of Libyan ground forces during their final advance on N'djamena which culminated in the ceasefire agreement of 16 December last.

Colonel Kadhafi's subsequently declared intention of merging Chad with Libya, coupled with his covert meddling in the affairs of several West African states, have made Libya many enemies among Black African leaders; most of his fellow Arab leaders have been angered by his continuous support of the regime of Ayatollah Khomeini in the Iranian-Iraqi conflict, and his sponsorship of terrorism and subversion on a global scale has left him with very few friends in the West. Nevertheless, reliance on Libyan oil has overcome the scruples of several western industrial countries, however distasteful and embarrassing they find the maverick Libyan leader's irresponsible activities, enabling Libya to avoid total dependence on the Soviet Union for sophisticated weapons.

Thus, the arsenals of all three components of the Libyan armed forces, and that of the LARAF in particular, today present a mélange of eastern and western weaponry, with spares and maintenance difficulties commensurate with its diversity. Indeed, it is difficult to see how Libya, despite the formidable nature and quantity of much of the equipment that it has amassed, could wage a sustained war against a reasonably well-equipped and determined antagonist without active Soviet assistance.

A paper tiger?

Libyan relations with neighbouring Egypt are such that the latter might well be prepared to mount an invasion of the former, citing the proven involvement of Kadhafi's secret service in assassination plots against President Sadat as a pretext. Such an assault might possibly coincide with an uprising within Libya under the banner of the "Libyan National League" led by Mustafa al-Durki, currently based in Cairo. An action of this sort might well have the blessing, if not the active support, of the US government, as Secretary of State Alexander Haig of the new administration in Washington has made plain his anxiety to see Libya's rôle as advocate and supporter of world terrorism terminated.

Another potential catalyst in an Egyptian-Libyan confrontation is provided by Colonel Kadhafi's overtly aggressive intentions towards the sprawling desert state of Sudan, on whose border Libyan forces were allegedly massing in February. This move resulted in Sudan's President Numeiry issuing an urgent warning to the West that the situation was "extremely serious", while a spokesman for the Egyptian government, which is convinced that Kadhafi is being urged by Moscow to destabilise Sudan — one of the few Arab countries still friendly with Egypt — warned, "If Kadhafi moves further, the Egyptian Army and Air Force will be immediately involved. The first Libyan soldier to attack Sudan will be repulsed by Egypt. We know that Sudan could be our Achilles heel."

Should such a conflict occur, it is difficult to foresee what part will be played by and how effective will be the LARAF in view of the questionable loyalties of a proportion of its indigenous personnel and the very large number of expatriates flying and maintaining its aircraft. There have been many instances of LARAF defections, both publicised and unpublicised. Among the more spectacular examples of such have been the attempted defection on 18 July last year of a Libyan MiG-23 *Flogger* pilot who crashed into a mountain near Castelsilano, in southern Italy, and the more successful Libyan defector who landed his MiG-23 at Maleme Air Base, Crete, on 11 February and was granted asylum. His aircraft was, incidentally, relinquished within three days following a Libyan threat to cut off oil supplies to Greece if the MiG-23 was not returned immediately! It would seem unlikely, however, that Moscow will allow the seconded Soviet forces to take a back seat and permit its immense Libyan investment to be wasted, and thus the Soviet element of the LARAF could well assume vital importance to Colonel Kadhafi.

Taken at face value, the LARAF presents a formidable picture, but the bulk of its equipment is concentrated on very few bases within the 680,000 square miles (1 761 000 km^2) of the Republic — there are only six bases regularly accommodating combat units — and although there are now a substantial number of airstrips, these lack the facilities necessary for them to be able to accept combat units in an emergency. The principal bases are now comparatively well protected following the attacks on El Adem, close to Tobruk and the nearest major LARAF base to the Egyptian border, and Al Kufra, to the south, in the Libyan Desert, during 19-25 July 1977, when a series of skirmishes took place between Egyptian and Libyan forces*. Base defences include Soviet-supplied mobile ZSU-23-4 quad-mounted cannon, Czechoslovak M-53/59 twin cannon and Swedish 40-mm L/70 cannon, and an array of Soviet surface-to-air missile systems augmented by 60 Thomson-CSF/Matra Crotale low-level missiles. But the fact that these bases are so few renders them vulnerable and this vulnerability is exacerbated by the lack of an effective early warning system.

The bulk of the Soviet-manned element of the LARAF is based at Okba Ben Nafi, the former Wheelus Field and the

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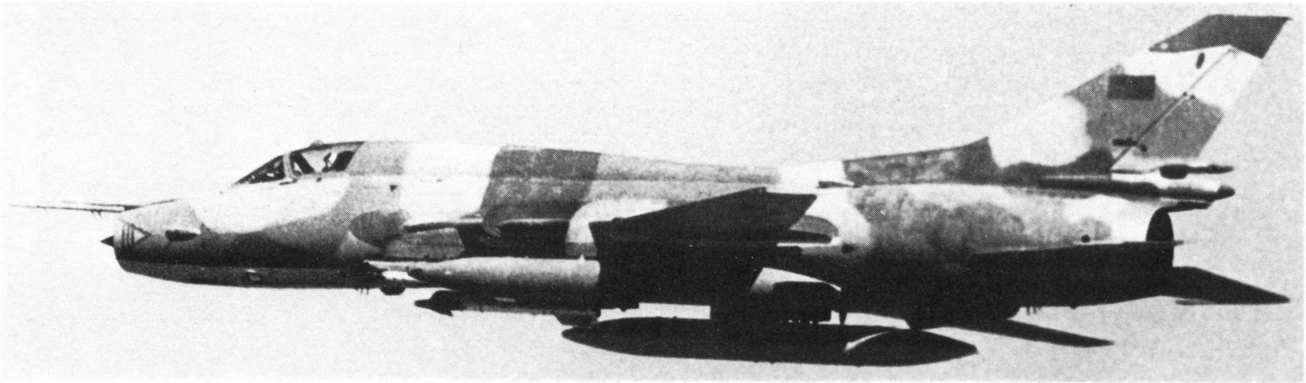
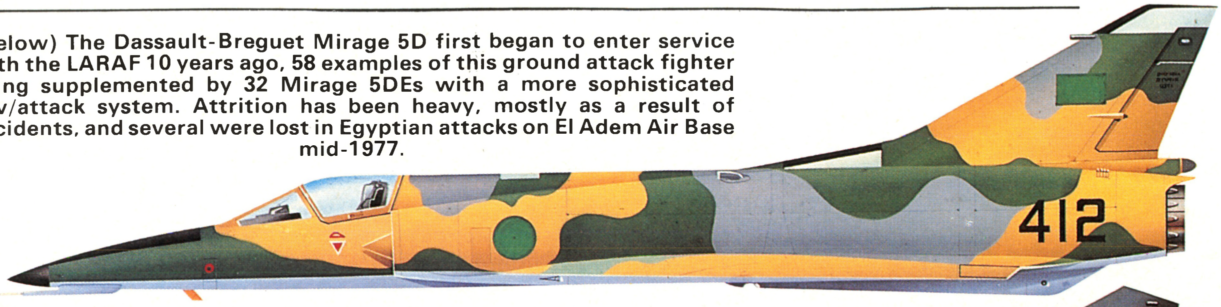
**It will be recalled that when, at the beginning of 1970, it was first revealed that France was to furnish Libya with Mirages, the then French Minister of Defence, M Debré, said, in a statement to the National Defence Committee, that the Libyan government had given assurances that French arms would not be used in Chad!*

**Colonel Kadhafi was, at this time, reportedly anxious to retaliate by using the Soviet-manned Blinder squadron to attack Cairo, but was overruled by Moscow.*

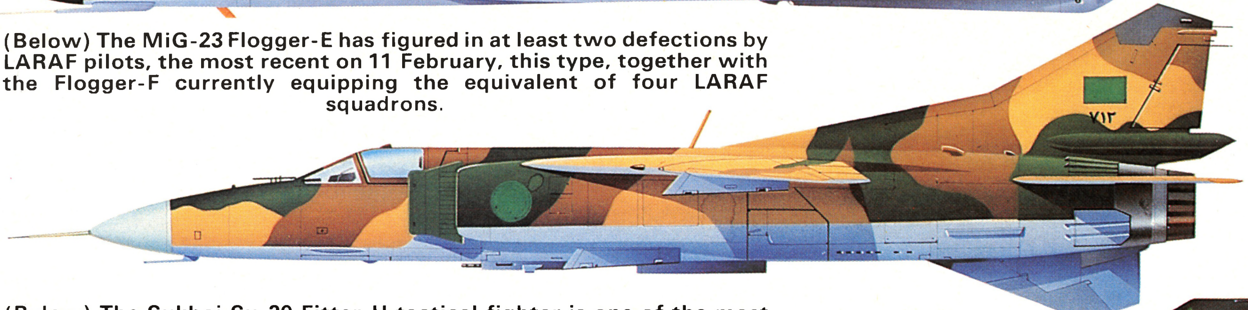
(Head of opposite page) A LARAF MiG-25 Foxbat-A interceptor toting AA-6 Acrid AAMs photographed over the Mediterranean by an aircraft from the US Navy's 6th Fleet, and (below) a LARAF Su-20 Fitter-H tactical fighter with AA-2 IR-homing Atoll AAMs on the inboard wing pylons. Both types are based primarily at the Okba Ben Nafi AB.



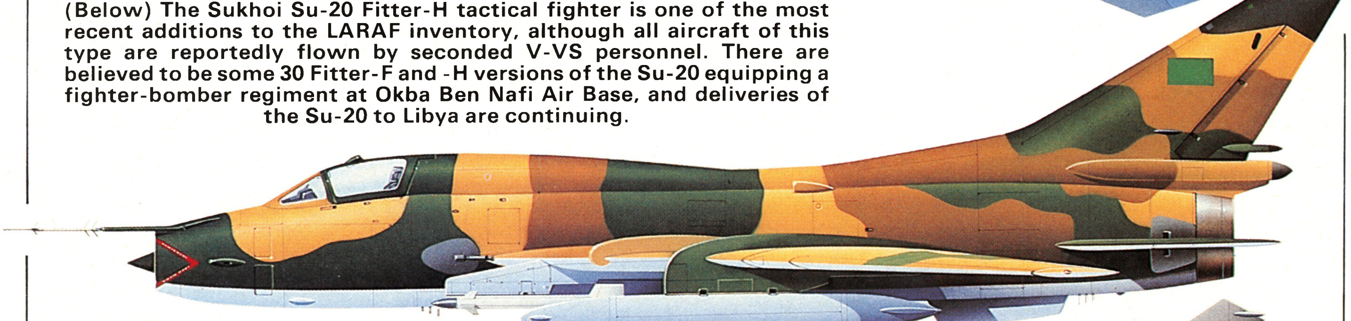
(Below) The Dassault-Breguet Mirage 5D first began to enter service with the LARAF 10 years ago, 58 examples of this ground attack fighter being supplemented by 32 Mirage 5DEs with a more sophisticated nav/attack system. Attrition has been heavy, mostly as a result of accidents, and several were lost in Egyptian attacks on El Adem Air Base mid-1977.



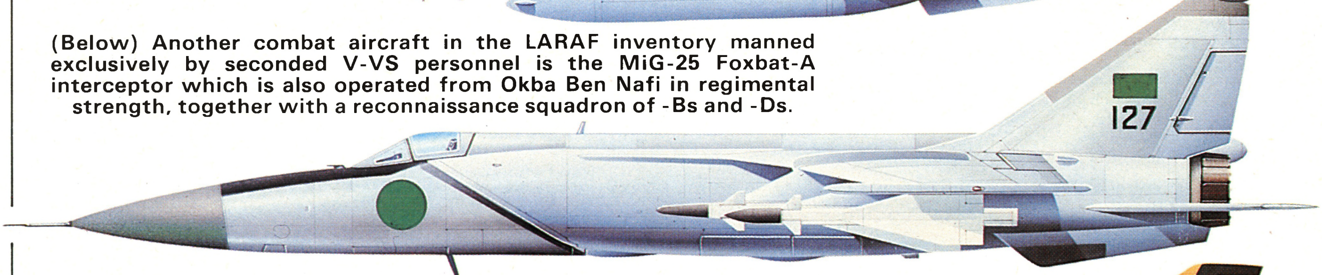
(Below) The MiG-23 Flogger-E has figured in at least two defections by LARAF pilots, the most recent on 11 February, this type, together with the Flogger-F currently equipping the equivalent of four LARAF squadrons.



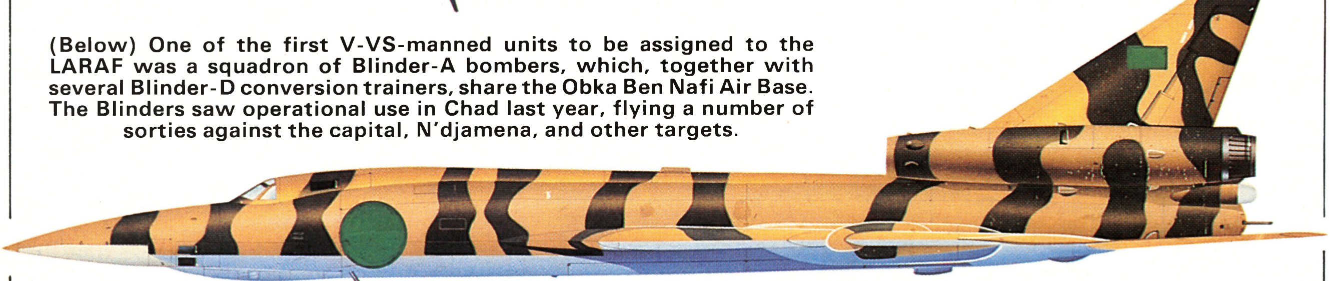
(Below) The Sukhoi Su-20 Fitter-H tactical fighter is one of the most recent additions to the LARAF inventory, although all aircraft of this type are reportedly flown by seconded V-VS personnel. There are believed to be some 30 Fitter-F and -H versions of the Su-20 equipping a fighter-bomber regiment at Okba Ben Nafi Air Base, and deliveries of the Su-20 to Libya are continuing.



(Below) Another combat aircraft in the LARAF inventory manned exclusively by seconded V-VS personnel is the MiG-25 Foxbat-A interceptor which is also operated from Okba Ben Nafi in regimental strength, together with a reconnaissance squadron of -Bs and -Ds.



(Below) One of the first V-VS-manned units to be assigned to the LARAF was a squadron of Blinder-A bombers, which, together with several Blinder-D conversion trainers, share the Obka Ben Nafi Air Base. The Blinders saw operational use in Chad last year, flying a number of sorties against the capital, N'djamena, and other targets.



relinquishing of which by the USAF is still celebrated by Libyans as a national holiday. MiG-25 *Foxbat-A* interceptors are operated from here in regimental strength (ie, three squadrons each of 12-14 aircraft, plus reserves), together with an attached reconnaissance squadron operating a mix of *Foxbat-B*s and *-D*s. Okba Ben Nafi also accommodates the long-range bombing element consisting of one squadron operating *Blinder-A*, plus several *Blinder-D*s, with a total complement of 18 aircraft, and the interdiction and *CAS* component comprising an as yet under-strength regiment with some 30 Su-20 and Su-22 *Fitter-F* and *-H* fighter-bombers.

Part of a dual-rôle (intercept and ground attack) force of MiG-23 *Flogger-E*s and *-F*s — approximating to four squadrons with a total strength of some 50 aircraft — is deployed to El Adem, and, presumably as a gesture to Libyan sensibilities, includes a number of Libyan (and Palestinian) pilots in its personnel complement, and some conversion training is undertaken with five two-seat *Flogger-C*s. V-VS personnel also provide the bulk of the pilots, gunners and navigators of the equivalent of a regiment of Mi-24 *Hind-D* gunship helicopters, two squadrons of Mi-8 *Hip-C* and *-F* helicopters mostly being manned by Libyan personnel, but all major servicing and maintenance of these and other Soviet aircraft types is undertaken by V-VS personnel, primarily at Okba Ben Nafi.

Numerically the most important combat aircraft type in

A LARAF Dassault-Breguet Mirage F1AD, deliveries of 16 of which were completed some 18 months ago to equip one attack squadron, reportedly based at El Adem, near Tobruk.

LARAF service is the Dassault-Breguet Mirage in several versions, Libya having placed orders in France in early 1970 for no fewer than 110 of the delta-winged Mirage 5 series, follow-on orders placed four years later calling for 38 swept-wing Mirage F1s. Deliveries of the delta-winged Mirages commenced to the LARAF in the second half of 1971, these comprising 10 Mirage 5DD two-seat trainers, 58 Mirage 5D ground attack fighters with simplified nav/attack systems, 32 Mirage 5DE strike fighters and 10 Mirage 5DR tactical reconnaissance aircraft, and were completed in May 1974, by which time only 25 LARAF pilots had qualified on Mirages! Deliveries of the swept-wing Mirages, consisting of 16 Mirage F1AD attack aircraft, 16 Mirage F1ED strike interceptors and six two-seat Mirage F1BD trainers, commenced in 1977.

In the decade since the first Mirages were taken into the LARAF inventory, attrition has been comparatively heavy, but, theoretically, there are currently five LARAF Mirage-equipped squadrons, varying in strength from 12 to 22 aircraft, and an OCU. These consist of one Mirage F1AD-equipped and two Mirage 5D-equipped ground attack squadrons, one Mirage F1ED-equipped interceptor squadron, and one strike squadron operating the Mirage 5DE with an attached tactical reconnaissance flight of Mirage 5DRs. Fewer than 40 per cent of the pilots of these squadrons are Libyans, the majority being seconded Pakistan Air Force personnel who also man the OCU that flies a mix of Mirage 5DDs and F1BDs.

Training and transport support

The LARAF Academy at Zawia, 125 miles (200 km) east of Tripoli, which has been operating for six years, having been officially opened on 31 March 1975 by Colonel Kadhafi, provides both basic and advanced flying training courses, its instructional staff comprising five nationalities with a preponderance of Pakistanis and Yugoslavs. Prior to commencing the two-and-a-half year course at Zawia, LARAF flying cadets have theoretically completed 100 hours primary and basic instruction on the Siai Marchetti SF.260 at one of the paramilitary flying schools formed over the last few years in a major effort to provide a sizeable pool of pilots from which the Academy could draw 50-70 cadets twice yearly. Somewhat protracted negotiations led to contracts being placed with Siai Marchetti for a total of 230 SF.260s of which approximately 100 were to be delivered as knocked-down component kits for final assembly at a factory built with Efim-Agusta assistance 250 miles (400 km) from Tripoli. Deliveries of the Libyan-assembled SF.260s were scheduled to commence last year, but various difficulties have been encountered with this programme.

After further instruction at Zawia on the SF.260, future jet combat aircraft pilots convert to the G-2A-E Galeb basic trainer which entered service with the Academy in 1976. The Mostar production line for this Yugoslav training aircraft was specifically reopened to cater for a LARAF order for 50 aircraft, the delivery of which was completed last year. Some armament training and advanced instruction is provided with the Aero L 39ZO Albatros, deliveries of some 30 having commenced late 1978. The fewer than 30 per cent of cadets that are not washed out by this stage proceed to the OCU for eight-ten months advanced flying and tactical and weapons training primarily on one or other two-seat version of the Mirage.

Considerable importance is currently being attached to the expansion of the transport component of the LARAF, earlier

AERITALIA
I-GAIT

(Above right) The Aeritalia G.222T, a Libyan-sponsored Tyne-engined development of this sturdy and highly-capable Italian general-purpose transport, is scheduled to begin to enter the LARAF inventory later this year. (Below) The Mirage F1ED strike interceptor which equips one LARAF squadron.

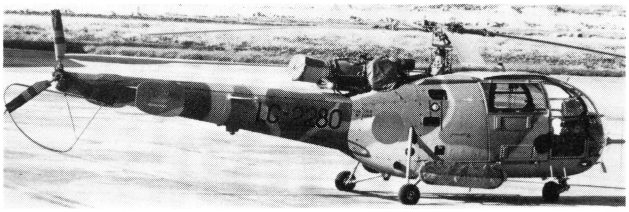
efforts to increase the service's heavy logistic support capability having been stymied by the embargo maintained since 1973 by successive US administrations on the export to Libya of a second batch of eight Lockheed C-130H Hercules transports. One of the original batch of eight Hercules was lost in Colonel Kadhafi's abortive attempt to support the tottering regime of Idi Amin in Uganda*, and operations of the remaining seven have been supplemented over the past year by two Il-76M *Candid* heavy freighters, which, ostensibly included in the fleet of Libyan Arab Airlines, were displaying LARAF insignia when operating into North Yemen on military tasks late last year. LARAF has also acquired two civil L-100 Hercules, one via a Luxembourg dealer and another through a bogus company registered in Delaware. It is known that the LARAF has had a requirement for 10-12 large freighters with the short-field capabilities of *Candid* for some years — possibly for the support of some of the covert operations in other African countries in which Colonel Kadhafi frequently indulges — and it was unofficially reported that a sizeable order for the Ilyushin transport had been placed on behalf of LARAF in 1978†.

Some expansion of the LARAF transport force commenced with the initiation of deliveries on 20 February of the Libyan-sponsored Tyne-engined Aeritalia G.222T, 20 of which are on order with a further 10 on option, and LARAF at times operates some of the 10 Fokker F27 Friendships (nine Series 600 and one Series 400) that are officially on Libyan Arab Airlines strength. A half-dozen aged Douglas C-47s remain, but these are largely used for multi-engine and crew training.

Most of the sizeable helicopter fleet possessed by the LARAF has been acquired from France and Italy. From the former, the LARAF obtained eight Aérospatiale SA 321M Super Frelons for search-and-rescue and anti-submarine-warfare missions, augmented late last year by four SA 321 GMs, some of these now reportedly being equipped to launch Whitehead Motorfides A244 lightweight homing torpedoes acquired last year from Italy. France has also supplied a number of SA 316B Alouette IIIs, some of which are fitted with periscopic sights and launch rails for anti-armour missiles (possibly AT-2 *Swatters*), these being supplemented recently by a more substantial number of SA 342 Gazelles for both liaison and anti-armour operation. The larger proportion of the 40 or so Gazelles procured have been assigned, however, to the Army aviation component, which is a steadily expanding helicopter force operating a number of Alouette IIIs and Agusta Bell AB 206 JetRangers. LARAF and Libyan Army helicopter pilots regularly train at an *Armée de l'Air* base near Marseilles, prior to taking over the Alouette III and Gazelle helicopters as they are delivered by Aérospatiale. It is noteworthy that this training programme and the helicopter deliveries have continued uninterrupted despite many Libyan affronts to France, such as the Kadhafi-sponsored sacking of the French Embassy in Tripoli 16 months ago. Such is the power of oil!

From Italy, the LARAF has obtained 20 Boeing Vertol CH-47C Chinook medium-lift helicopters, which, licence-built by Elicotteri Meridionali, were delivered between 1976 and June last year, and are operated primarily on behalf of the Army. Considerable interest is being shown by both the LARAF and the Army aviation component in the Agusta A 109A, and at least two helicopters of this type are expected to be delivered shortly for evaluation by both services.

If quantity and equipment modernity are taken as a guideline, then the LARAF is today a formidable force. But these are not the only factors to be taken into account. There is increasing evidence to suggest that the days of Libya's erratic and fanatical leader may be numbered; that the day may soon dawn when the LARAF may be called upon to prove itself a potent force or a paper tiger. On that day, will the brief of the seconded Pakistani and other expatriate pilots extend to participating in all-out war and will the indigenous personnel complement of the LARAF prove loyal to a little-loved regime? Can the LARAF operate so many aircraft effectively from so few bases, and what of the Soviet forces? Surely even Moscow cannot place a great deal of confidence in a Libyan leader whose first comment on the advent of the Reagan administration in the USA was a claim that the North American Indians originated in Libya! □



(Below) One of the eight SA 321M Super Frelon helicopters acquired by the LARAF from Aérospatiale, several of which are now reportedly equipped to launch A 244 lightweight homing torpedoes, and (above right) one of the SA 316B Alouette III helicopters supplied to the Libyan Army. Some Libyan Alouette IIIs are fitted with periscopic sights and have launch rails for anti-armour missiles.

**This adventure resulted in 900 Libyan dead and Colonel Kadhafi having to pay ransom in order to gain the return of the survivors.*

†The V-VS is believed to have as yet only some 75 Il-76s in service and with production running at 30 annually to meet both military and commercial requirements, it would seem unlikely that LARAF will receive any substantial quantity of these highly effective transports in the immediate future.

PAKISTAN——————————— from page 168

units for night and all-weather air defence. As the first PAF unit to receive the Mirage in 1969, from initial procurement of 24 Mirage IIIEPs, plus three Mirage IIIRPs for tactical recce and three Mirage IIIDP two-seat trainers, No 5 Squadron at Sargodha specialises in air defence and air superiority rôles, armed with MATRA R 530 and 550 Magic air-to-air missiles supplementing its twin internal DEFA 30-mm cannon.

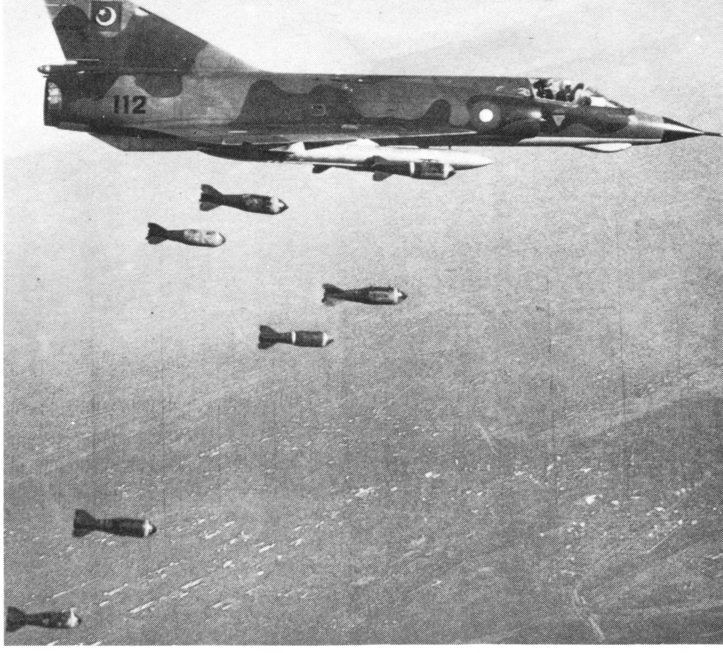
The remaining three PAF Mirage units, operating aircraft subsequently delivered, including a further 10 Mirage IIIRPs to equip a single reconnaissance squadron; 33 Mirage 5PA non-radar equipped strike-interceptors; and two Mirage 5DP two-seat trainers, form Pakistan's tactical air element, controlled through Air HQ by the recently-created Operations Group South in the Karachi area. In addition to the three Mirage squadrons, Ops Group South controls units at Masroor, including the sole remaining bomber unit — No 7 Squadron — with 10-12 Martin B-57s and a primarily night rôle, and at Malir and Quetta, as well as radar control and reporting sites. It also undertakes liaison and co-ordination with army and naval units in the south of Pakistan.

The PAF tactical element will gain at least one additional squadron from imminent deliveries of a follow-up batch of 32 Mirage 5PAs ordered in 1979 at a cost of $330m, and bringing total Pakistani procurement of these Dassault-Breguet fighters and trainers to 107. All the PAF Mirages have provision for jettisonable SEPR 844 rocket booster packs to improve high-altitude interception performance if required, and an initial batch of 30 aircraft is currently being updated by the installation of Litton LW-33 nav/attack systems, incorporating Thomson-CSF head-up displays.

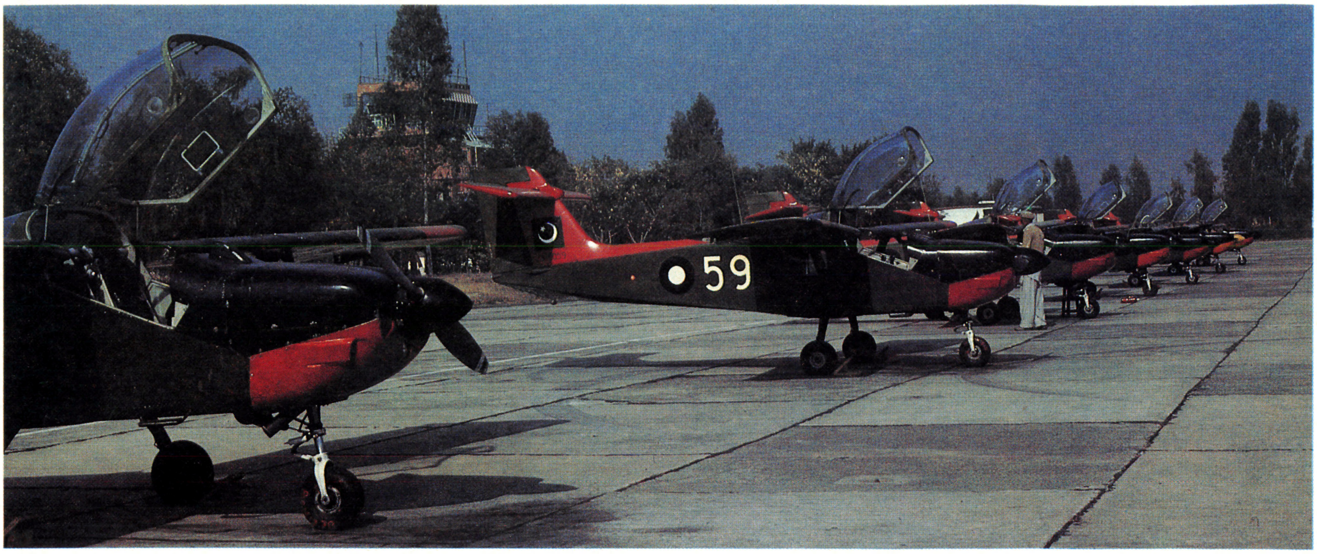
Although the PAF has found the Mirage very expensive to buy and to operate, with costly spares, it has a high regard for this type's operational capabilities, and has shown considerable interest — extending to recent flight evaluation of the two-seat version — in the Mirage 2000 as a possible successor. The rôles and capabilities of its current Mirages will be extended over the next two years by procurement of AM 39 Exocet ASMs for anti-ship use, to supplement the MATRA Durandal anti-runway penetration bombs already in PAF service. Since early 1978, operational availability of the PAF Mirage force has been further improved by the local completion of airframe and, in the near future, engine overhauls (after 11 years or 1,800 flying hours, and 600 hours, respectively) at another specialised Rebuild Factory in the Kamra Aeronautical Complex.

Further infrastructure expansion by the PAF includes the extension of former emergency airstrips at Multan, Sukkur and Jacacobad for operational use, and the construction of new coastal air bases in Baluchistan, plus another near Hyderabad. Maritime reconnaissance and patrol, formerly undertaken by PAF Grumman HU-16A amphibians, was taken over towards the end of 1975 by the Pakistan Navy when it took delivery from France of three refurbished ex-*Aéronavale* Breguet Atlantic twin-turboprop ASW aircraft, based in the Karachi area.

Pakistan Naval Aviation also includes half-a-dozen Westland Sea King Mk 45 ASW helicopters, purchased from


A Dassault-Breguet Mirage IIIEP of No 5 Squadron releases eight 500-kg bombs in a shallow dive. Four squadrons of Mirages comprise the main PAF strike/recce force.

(Below) The PAF has 24 Mirage IIIEPs such as this, used principally for all-weather and night interception. (Above right) One of the 28 Mirage 5PA strike-interceptors now in service with the PAF, about to be supplemented by delivery of 32 more.

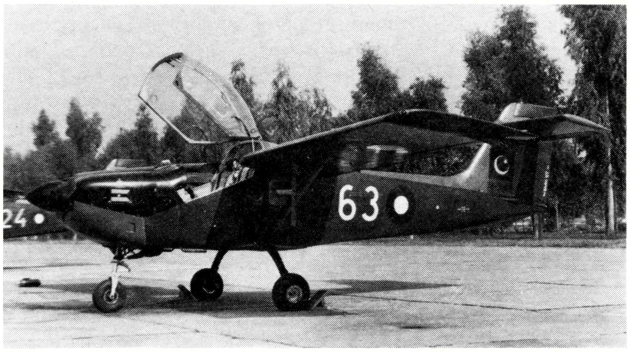


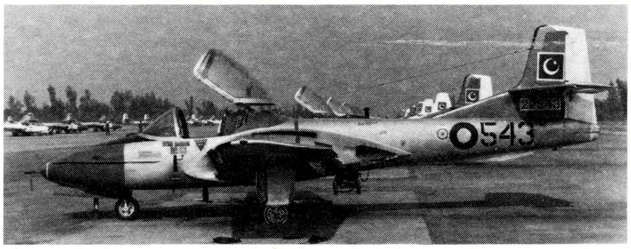
the UK in 1975, four of which have additional anti-shipping strike capability from their armament of Aérospatiale AM 39 Exocet ASMs. PNA equipment is completed by a number of Aérospatiale SA 319B Alouette III helicopters providing second-line support and training capability, although some are equipped and operated for ASW duties from frigates of the Pakistan Navy. All basic pilot and crew training is provided, however, by the PAF, which also effectively exercises joint control of the naval air wing since it is commanded by an air force Air Commodore.

Logistic and tactical air support for the PAF and other services is provided by the Transport Wing, with HQ at Chaklala, Rawalpindi. Principal equipment comprises the Lockheed Hercules, of which some 17 C-130B/Hs and L-100s have so far been received by Pakistan, including half-dozen or more transferred from Iran, although at least five have been destroyed to date in accidents. Apart from four C-130Bs in the adjacent Transport Conversion School, responsible for multi-engine pilot and crew training, including personnel from the Pakistan Navy, the remaining Hercules are operated by No 6 Squadron from Chaklala on re-supply flights to the mountainous northern regions, particularly in the winter, and in tactical transport rôles.

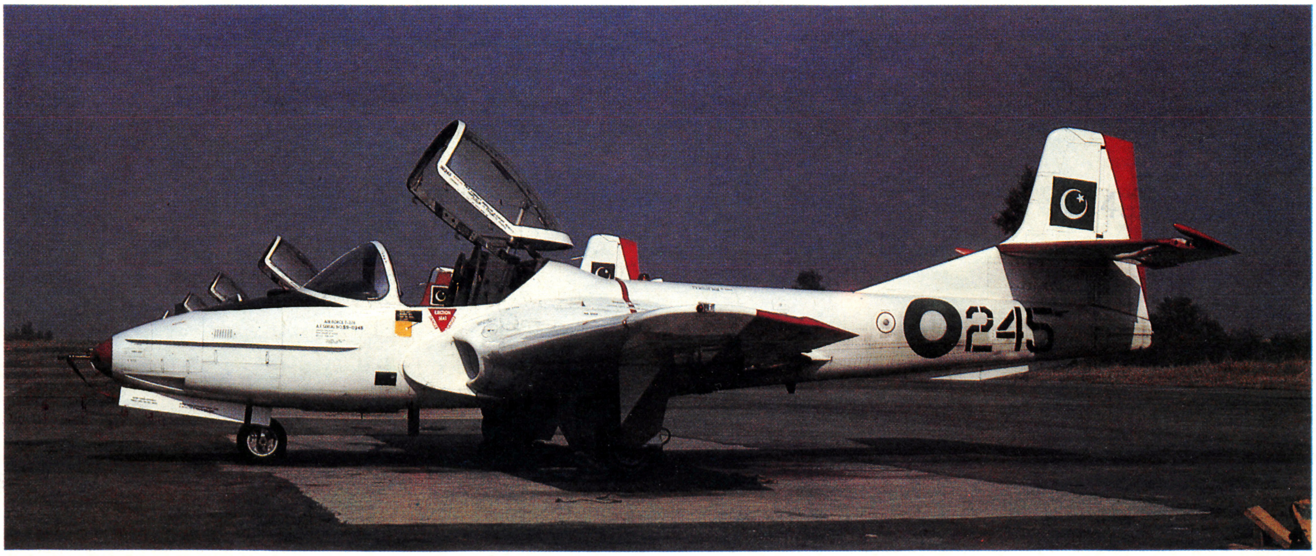
The re-supply flights, through the Indus Valley and among the Karakoram Mountains extending to more than 25,000 ft above sea level, are among the most hazardous in the world, through unpredictable weather, turbulence, icing, etc, and also involve operation into semi-prepared airstrips at Gilgit and

(Above and below right) Saab MFI-17 Safari primary trainers assembled at Risalpur and used by the PAF, with the local name Mushshak, as primary trainers at the Academy there.

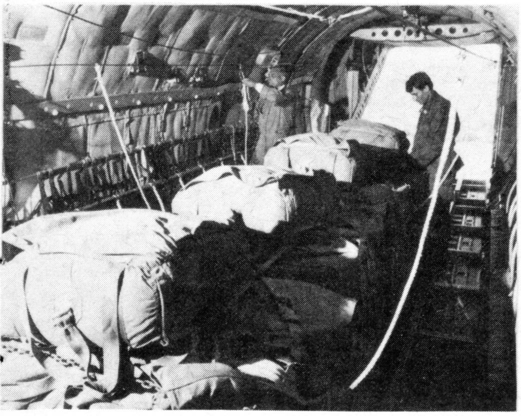




(Above right and below) Cessna T-37Bs of the PAF Academy at Risalpur, used for basic training following an initial 44 hours on the Mushshak.



our trail in the sky



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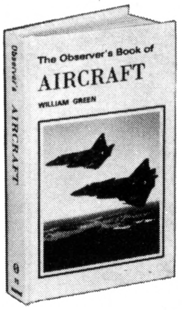

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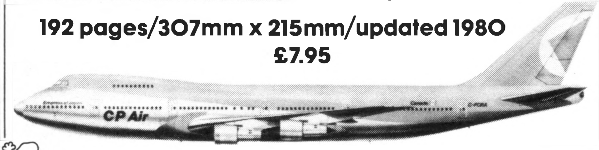

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Skardu. The C-130s have proved excellent for their demanding tasks, although the PAF has updated its C-130Bs and Hs by the installation of Allison T56A-15 turboprops, in place of the original -7s, to provide additional power and improved fuel consumption. Modifications have also had to be made to extend the fatigue lives of the mainplane mainspars.

Among the rôles of the Transport Conversion School, which provides specialised courses for C-130 captains, co-pilots, navigators, flight engineers, crew chiefs and load-masters, that of multi-engine training really requires a small turboprop type, which the PAF is currently considering. One of No 6 Squadron's C-130s is earmarked for occasional use as a VIP transport, for which a palletised custom interior is available, but the main rôle of government transport and communications is undertaken by the third unit in No 35 (Transport) Wing, which is No 12 (VIP) Squadron. This has a variety of aircraft including the Presidential Fokker F27 and Dassault-Breguet Falcon 20, plus a number of smaller twins, including a Piper Seneca II. Other PAF communications types operated at station level include Aero Commander 680Es, Beech Barons, Travel-Airs and Twin-Bonanzas, and Cessna 172s, while SAR is undertaken by Kaman HH-43B Huskie and Aérospatiale/Dhamial Alouette IIIs.

Pilot training in the PAF starts with 10 hours of pre-selection grading on locally-assembled Saab MFI-17 Mushshak (Expert) primary trainers and a four-year degree course at the PAF College, Sargodha, on aerosciences. After receiving their BSc degrees, successful students move on to the PAF Academy at Risalpur for a year's "wings" course, during which a further 44 hours are flown on the Mushshak, followed by 120 hours basic jet training on the Cessna T-37. Suspension rates for Mushshak students are lower than was experienced with the North American T-6s previously used, but remain at about 15-20 per cent in the T-37 stage.

Pakistan is in the process of procuring a total of 117 MFI-17s, all of which have been assembled locally, initially from major imported components, then from knocked-down parts and, from later this year onwards, from imported materials. MFI-17 assembly in Pakistan started in 1976 with the first 10 at Risalpur, where a total of 87 was scheduled for completion by mid-1981. The last 30 MFI-17s in the present PAF programme will be built under licence at a new Aircraft Manufacturing Factory now nearing completion at Kamra, where, with the Mirage and F-6 Rebuild Factories, it will provide the basis of an aerospace industry for Pakistan.

Machine tools and a new 10,000 psi hydraulic press in the three factories at Kamra are already committed to the manufacture of some 4,500 components for the aircraft concerned, and will be capable of completing additional programmes when MFI-17 production reaches its currently scheduled completion date in 1982. The Pakistan Aeronautical Complex has sales as well as production rights for the MFI-17 in certain areas of the Middle and Far East, and export orders are likely to be sought in addition to new licensed construction programmes.

Some of the Pakistani-assembled MFI-17s have been delivered to the Army Aviation Wing for liaison duties, but about 45 or more are operating with the PAF at Risalpur, in addition to those at Sargodha. A similar number of T-37s are also operated by the PAF Academy, following the lease of an additional quantity from the USAF in 1979-80, to supplement those originally delivered to Pakistan in 1963. No replacement requirement is currently foreseen by the PAF for its T-37s, with which it is now entirely happy following the 1970 spin test programme initiated by the USAF to standardise recovery procedures. The flight-test programme conducted at the USAF Test Center, Edwards AFB, Calif, validated a single spin recovery procedure for updated T-37B trainers, with all post-1961 airframe, avionic and engine modifications.

PAKISTAN AIR

(Above) Pakistan Army paratroops leave the twin doors of an (ex-Iranian AF) C-130B. (Below) The Fokker F 27 presidential transport operated by No 12 (VIP) Squadron from Chaklala.

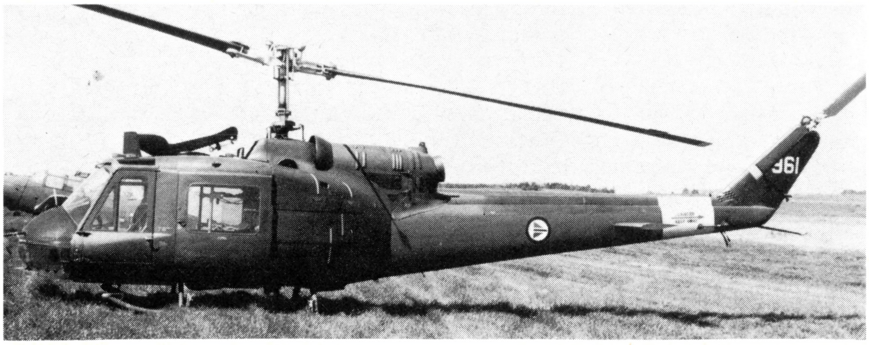
A completely new and ultra-modern complex, offering accommodation for up to 625 flight cadets, as well as gymnasium and sports facilities, lecture rooms and so on, is nearing completion at Risalpur for the PAF Academy. It is scheduled for completion in 1982, and will offer a substantial increase in capacity from the present intake of up to 150 students per year.

Current PAF policy is that all student pilots must be combat-qualified, for which the next stage of training is the Fighter Conversion Unit at Mianwali. As described elsewhere, two-seat versions of the MiG-17, developed and built by the Chinese at Shenyang and designated FT-5s, have replaced the Lockheed T-33s formerly operated by No 2 Squadron for advanced training at the FCU, although the former unit still operates the American aircraft, plus a few RT-33s, on second-line duties such as target facilities, photograph survey, etc.

Final stage of pilot training is completed at one of several Operational Conversion Units, which also have combat rôles and squadron numbers. Those for the F-6 received the first of their new FT-6 two-seat trainer versions of the MiG-19 in September 1980, and these now equip the OCUs at Mianwali (No 14 Sqn), Peshawar (No 26 Sqn) and Sargodha (No 25 Sqn), alongside the single-seat variant. The Mirage OCU is at Rafiqui, where most students convert after an initial tour on F-6s.

Other PAF flying training units include the Flying Instructors' School at Risalpur, using Academy T-37s, and the Combat Commanders' School at Sargodha, with two squadrons operating F-6s and Mirage 5s to develop fighter leaders, tactics and weapons, as well as having secondary combat rôles. The PAF offers training facilities for Arab students from many Middle Eastern countries, and also maintains training and combat teams with the air forces of Abu Dhabi, Libya, Saudi Arabia and elsewhere. Ground technician training is undertaken at the College of Aeronautical Engineering, Korangi Creek. □

TALKBACK



Reader Odd G Nilsen, of Oslo, writes to say that the reference in the "Model Enthusiast" column of AIR INTERNATIONAL/*December 1980 (page 290), to Esci's model of the UH-1D representing a Royal Norwegian Air Force machine is incorrect. The Royal Norwegian Air Force has only the UH-1B version of the Bell helicopter (as illustrated here), serving in Lebanon and not in the Sinai as mentioned. The UH-1B does not have the UN flag on the fuselage, but only the Royal Norwegian Air Force insignia plus the letters UN under the cabin windows and under the fuselage.*

Soviet WWII unit designations

REFERRING to the captions to the illustrations accompanying *Lavochkin's Timber Termagant* (January issue), I would like to make some comment. It does not seem to be generally known that the numeration of the Soviet Guards Aviation Regiments in WWII was arranged in three parallel series, all commencing from number one! The superficially confusing system was a logical consequence of the original organisation of the Soviet Air Forces which consisted of three *independent* Commands. These were the Air Forces of the Red Army (VVS KA), basically consisting of Air Armies (VA) and Air Corps of the High Command Reserve (AK RVGK); the Naval Air Forces (VVS VMF), each Fleet having its own Air Force, and finally the Long-range Aviation (ADD) which existed as an independent Command until 6 December 1944, when it was reorganised as the 18th Air Army under the command of the VVS KA.

When referring to a Soviet Air Regiment, therefore, and especially to a Guards Regiment, the Command concerned should always be indicated in order to avoid confusion (at least ADD or Fleet concerned, as appropriate). To provide examples, the 3 GvIAP of VVS KA was the former 155 IAP, while the 3 GvIAP of the VMF was the former 5 IAP of the Baltic Fleet (the 5 BAP of VVS KA became the 8 GvBAP), and finally the 3 GvAP DD was the former 750 AP DD. The Guards units of the Air Defence Fighter Aviation (IA PVO) were included in the VVS KA sequence.

The captions on pages 23 and 24 of the aforementioned feature should thus have referred to 3 GvIAP VVS KBF (Air Force of the Red Banner Order [K] Baltic Fleet [BF]), while the caption on page 25 should refer to 9 IAP VVS ChF (Black Sea Fleet). The photograph to which the last-mentioned caption was appended was taken on the Black Sea in May 1944 *before* the 11 ShAD of the Black Sea Fleet was transferred to the Baltic Fleet. Incidentally, Air Regiments were not transferred between the three major Commands but permanently assigned. References on page 42 to the "6th Fighter Aviation Division, Moscow Corps Command IA-PVO" should, in fact, read 6 Fighter Air Corps (IAK) of the Moscow Air Defence (PVO) zone. G A Grogoryev, who was awarded his HSU on 14 February 1943, was deputy squadron CO of the 178 IAP of 6 IAK PVO.

Carl-Fredrik Geust
SF-02430 Masala
Finland

Beech veteran

I HAVE enjoyed your excellent magazines ever since my first subscription many years ago. A minor correction for Vol 20 No 1 (January 1981) on p 40, Beech SNB-5P should be BuA No 09771. Originally a B185, c/n 434, NC 104D was sold on 18 December 1940 to the Evening News Publishing Co, Dayton, OH. It was impressed into the US Navy in February 1942, assigned to the Commanding General HSMC, Quantico, VA and underwent modernisation/re-manufacturing in the early 1950s.

Robert Parmerter
Schenevus, NY, USA

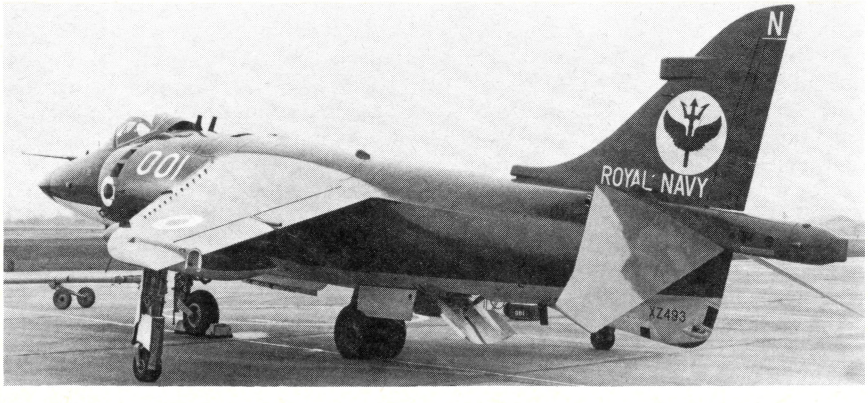
Trainer seats

ALLOW ME to amend one of Roy Braybrook's statements in his article "All that alphabet soup" concerning the USAF trainer Cessna T-37 (AIR INTERNATIONAL/February 1981). I think his assertion that the T-37 has no ejection seats is to be contradicted.

As a matter of fact, the T-37 has two ejection seats, including automatic shoulder harness locking feature, automatic canopy ejection system and man-seat separator. The seat provides safe escape during level flight at a minimum altitude of 100 ft (31 m) and speeds between 120-425 kts (222-787 km/h) IAS.

Hans Hilpisch
Alflen, Germany

Following publication in our previous issue of the account of Sea Harriers in service with the Fleet Air Arm, Peter March sends this illustration of one of the first aircraft to carry the insignia of No 801 Squadron, a blue winged insignia on a white background. No 801 was commissioned at RNAS Yeovilton on 26 February, under the command of Lt Cdr Nigel Ward, RN. With five aircraft, No 801 will embark on HMS Invincible *in mid-1981, with a primary rôle of air interception and secondary rôles of reconnaissance and strike.*



Singapore's Meteor

IN REPLY to the interesting letter from Mr J V Eftos (AIR INTERNATIONAL/February 1981) regarding "Relics in Singapore", I may be able to shed some light on the Meteor F Mk 8 he mentions. This aircraft almost certainly served with 1574 TTF based at Changi, Singapore, and possibly carried the serial WA880, WL180 or WE876 as these three F Mk 8s, amongst others, did operate with 1574 TTF. I was in Singapore myself between 1962-64 and at that time the Flight operated a mixture of TT 20s, F Mk 8s and a T Mk 7. The aircraft were unpainted (natural metal) with yellow/black undersurfaces and dayglo strips applied to the nose, rear fuselage and outer wings.

Upon disbandment of the Flight, one or two F Mk 8s were transferred to the RSAF and designated ground instructional airframes. I have a photograph of one F Mk 8 with SAF-TECH 3 applied over the original RAF fuselage serial.

P E Nops
Sleaford, Lincs

The last Tempests

I WAS interested in your article on the Hawker Tempest aircraft published in AIR INTERNATIONAL/February 1981. It is not true, however, that RAF Tempest operations ended at Sylt in 1953. The last Tempests were used by No 233 OCU, RAF Pembrey, S Wales.

I served on this unit from October 1953 until July 1955. During that period, the Target Towing Flight ("F" Flight, Gunnery Squadron), to which I was attached, used 10-12 Mk 5 TT Tempests, all with the static tow line. I cannot remember the exact number of aircraft in the unit, nor all the serial numbers, but I do recall the following: NV917, EJ631, EJ633, EJ669, SN127, SN219 and SN259.

In late June and early July 1955, Mosquito TT 35s arrived to replace the Tempests.

During this period, a number of pilots visited the unit, anxious to fly the Tempest before the breed became extinct. One group came from the Central Flying School.

The Tempests were retired to No 20 MU, the last two – EJ631 and SN259 — flying out of Pembrey on 20 July 1955. I was posted from the unit the following day.

A word about NV778, the Tempest on display at the RAF Museum, Hendon. The main airframe components of this exhibit were provided by SN219. This aircraft had served with No 56 Squadron, No 5 MU, No 6 MU, and was with No 233 OCU from October 1952 until July 1955, finally ending up at No 20 MU.

G Trunyer
Watford, Herts

Hawker's Tempestuous Finale

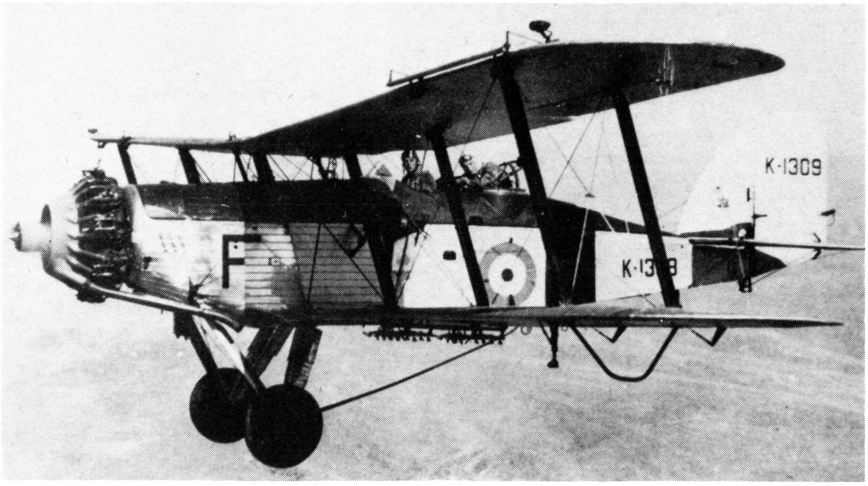
I was greatly interested in the excellent and well-illustrated article on the Hawker Tempest (AIR INTERNATIONAL/February 1981, pp 91 *et seq*). May I be permitted one or two comments?

Your drawings on p 93 include a scrap-view of the Mk V Srs 1 wing wherein the cannon barrels protrude from the wing and are shown as of equal length. Surely this was not so? The cannon were staggered, in order to accommodate closer together the magazines, as the blisters shown correctly in your drawing testify. The barrels of the inner cannon consequently protruded less far from the leading edge of the wing. The same arrangement held in the Srs 2 wing, the short-barrelled cannon not needing fairings, but the muzzles still of unequal protrusion, as shown in your cutaway drawing on pp 94-95.

The caption to the photo of JN757 (top of p 96) should read "... Tempest V Srs 1 ...", as the protruding cannon are clearly seen. Also, the stripes were NOT invasion stripes. They were applied from late 1943 on to both Typhoons and Tempests to distinguish them from Fw 190s, and consisted of three broad white stripes (24 in/61 cm) bordered and separated by four 1 in (2,5 cm) wide black stripes. Invasion stripes were three white separated by two black, all of 18 in (46 cm) width, and carried also around (later beneath only) the fuselage.

I saw a Tempest of the same batch, JN579, brand new at White Waltham, late in March 1944, so your shot is probably of similar vintage.

J R Marr
Weybridge, Surrey



Referring to the illustrations of No 5 Squadron Tempests in our February issue, Peter H T Green provides the additional illustration (below) of aircraft of this unit bearing the Maple Leaf emblem of that squadron, on the cowling, with "5" in white on a green leaf. He also provides the photograph (above) of a No 5 Squadron Westland Wapiti in India in 1937, on which the emblem can just be distinguished on the fin, but it appears that the marking was, in fact, seldom used either pre-war or in the early post-war period. It is currently carried on the squadron's Lightnings at Binbrook.

Fortresses sur l'Europe

The December 1980 issue of AIR INTERNATIONAL carries in the "In Print" section a rather truncated review of my book that is also misleading on several counts.

The fact that the book is written in French — an English edition is considered — may have put off your reviewer but I would nevertheless like to straighten a few points.

The book does *not* deal with the air war from 1943 onwards: it is a complete and historically accurate reconstruction of ONE day, 17 August 1943. The events of those 24 hours saw no fewer than 19 "premières" in the air war over Europe, NOT just Schweinfurt (the first attack on the ball-bearings capital of Germany) but also:

the first shuttle mission (8th USAAF) from England to Africa, via the Regensburg Messerschmitt factories;

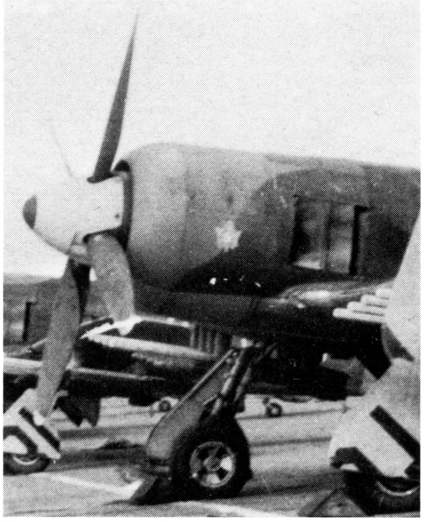
the first attack (RAF Bomber Command) on the V-weapon establishment at Peenemunde;

the first planned use of the "Organ-pipe" weapons by *Luftwaffe* night-fighters;

the first bombing of Southern France by the USAAF;

the first Allied losses of over 100 four-engined bombers;

etc...



The book is enjoying a tremendous success on the continent and I like to believe that English-speaking readers should not be deprived of the information that such a complete narrative of one slice of the WW II air operations exists outside the UK.

Many thanks and best wishes to your excellent magazine.

Roger Anthoine
01630/St Genis-P, France

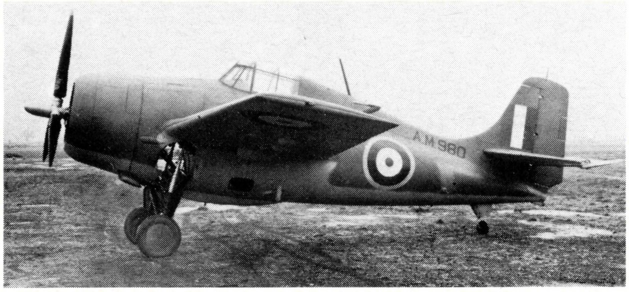
FITTER

from page 172

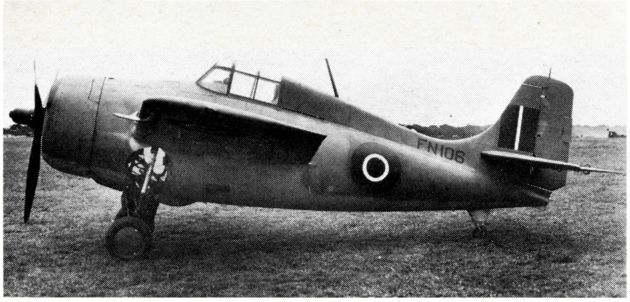
perhaps six-seven per cent as a result of the boost in internal fuel capacity, combat radii with fuel on the outboard wing pylons and a 4,410-lb (2 000-kg) external ordnance load being of the order of 270 miles (435 km) LO-LO-LO and 420 miles (675 km) HI-LO-HI. It is improbable that the M = 2·17 max speed can be reached more than transiently in clean condition, sea level max being in the vicinity of M = 1·06. The AL-21F-3 engine of *Fitter-C* affords a max military rating of 17,195 lb (7 800 kg) boosted to 24,700 lb (11 200 kg) with full reheat, and the ratings of the version of this engine installed in *Fitter-H* — and the two-seat *Fitter-G* which retains full operational capability — are not believed to be dissimilar, but the deeper and wider dorsal fairing increases internal fuel capacity to around 1,100 Imp gal (5 000 l).

The twin wingroot-mounted 30-mm NR-30 cannon are retained by *Fitter-H*, which, like preceding variable-geometry *Fitters*, has four fuselage and four wing stores stations. Two of the fuselage stations — at least, on export examples (eg, Libya) — are "wired" for *Atoll* IR-homing AAMs, providing some defence capability. The inboard wing and the fuselage stores stations can each lift "iron" bombs of up to 1,102 lb (500 kg), and the former and two of the latter may be fitted with adaptor shoes for radio command guidance AS-7 *Kerry* ASMs, or the various anti-radiation missiles, such as AS-9.

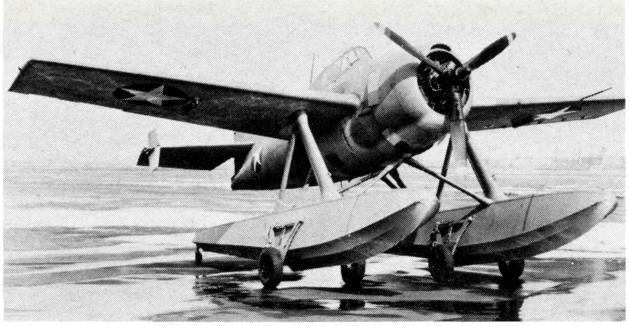
It is estimated that between seven and eight hundred of the variable-geometry *Fitters*, from *-C* to *-H*, are currently included in the FA line-up, others serving with regiments of the AV-MF, and production currently running at 17-18 monthly. The latest sub-types are undeniably very capable interdiction and close air support aeroplanes, underlining the success, from both cost and capability viewpoints, of the Sukhoi bureau's astonishing incremental design development policy which bids fair to ensure the survival of *Fitter* throughout the 'eighties! □



(Above) A G-36B Martlet II of the Royal Navy, and (below) a Martlet IV (F4F-4B) which was essentially similar to the US Navy's F4F-4 apart from the engine.



(Below) The sole example of the F4F-3S float fighter, development of which was abandoned as a result of inadequate speed performance.



GRUMMAN G-36A & B (MARTLET) USA

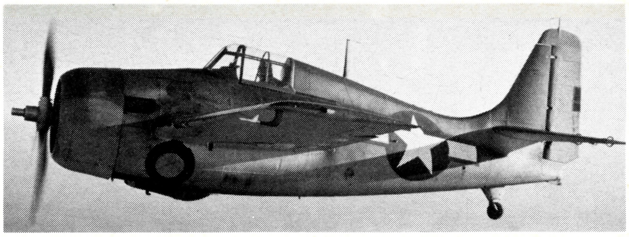
In 1939, Grumman offered an export version of the F4F-3 ordered by the US Navy as the G-36A, a contract for 81 aircraft being placed on behalf of France's *Marine Nationale*. Seven were in various stages of assembly when France fell and the entire batch was transferred to Britain which also placed a contract for 100 G-36As on its own account. Whereas the French contract aircraft were powered by the 1,200 hp Wright R-1820-G205A Cyclone, Britain selected the Pratt & Whitney S3C4-G Twin Wasp of similar power. The first (French contract) G-36A flew on 11 May 1940 and entered British service as the Martlet I, a contractual change resulting in the British order being switched to the G-36B with folding wings, this entering service as the Martlet II (although the first 10 were accepted with fixed wings). The 30 F4F-3As that had been assigned to Greece were also taken into the Royal Navy inventory as Martlet IIIs, and with the passage of the Lend-Lease Act, 220 aircraft essentially similar to the F4F-4 but with the single-stage R-1820-40B engine were assigned to the Royal Navy as Martlet IVs (F4F-4Bs), these becoming Wildcat IVs when British and US names were standardised in March 1944. The following data relate to the Martlet II. Max speed, 293 mph (471 km/h) at 13,000 ft (3 965 m). Initial climb, 3,050 ft/min (15,49 m/sec). Max range (clean), 890 mls (1 432 km). Empty weight, 5,425 lb (2 461 kg). Normal loaded weight, 7,580 lb (3 438 kg). Dimensions: As for F4F-4.

GRUMMAN (G-36) F4F-3S USA

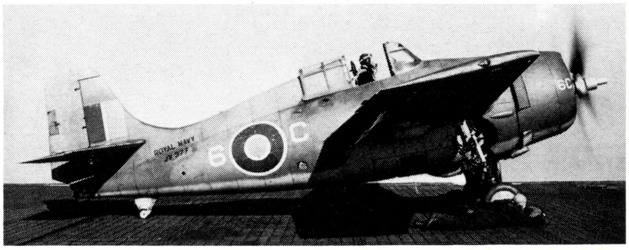
The appearance of the A6M2-N float fighter in the Aleutians prompted US Navy interest in a float-equipped version of the F4F-3 shipboard fighter. One example was therefore fitted with Edo designed and manufactured single-step metal floats, and with auxiliary rudders mounted near the tips of the tailplane flew on 28 February 1943. The need for additional keel area aft was revealed by initial trials and a large ventral fin was added to improve yaw stability. The floats and their bracing struts raised the fighter's weight by only some 500 lb (227 kg), and from calm water at normal loaded weight the F4F-3S could take-off within 34 seconds. However, the dramatic effect of float drag on speed performance led to an earlier contract to complete 100 F4F-3 Wildcats as float fighters being cancelled. Max speed, 266 mph (428 km/h) at 20,300 ft (6 185 m). Initial climb, 2,460 ft/min (12,5 m/sec). Max range, 600 mls (965 km). Empty weight, 5,804 lb (2 633 kg). Loaded weight, 7,506 lb (3 405 kg). Dimensions: Span, 38 ft 0 in (11,59 m). Length, 39 ft 1 in (11,91 m). Height, 18 ft $1\frac{3}{4}$ in (5,53 m). Wing area, 260 sq ft (24,15 m^2).

GRUMMAN (GENERAL MOTORS) FM WILDCAT USA

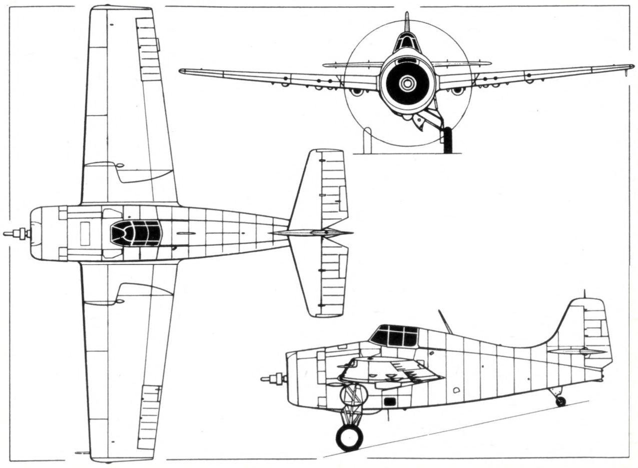
With the transfer of production of the Wildcat from the parent company to the Eastern Aircraft Division of General Motors, manufacture of the F4F-4 continued in slightly modified form

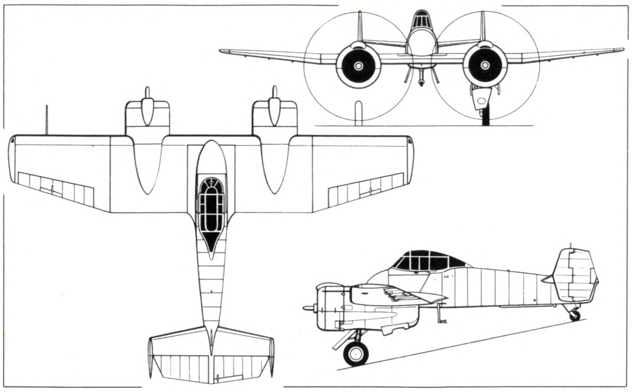


(Above) The definitive production version of the Wildcat, the General Motors-built FM-2.

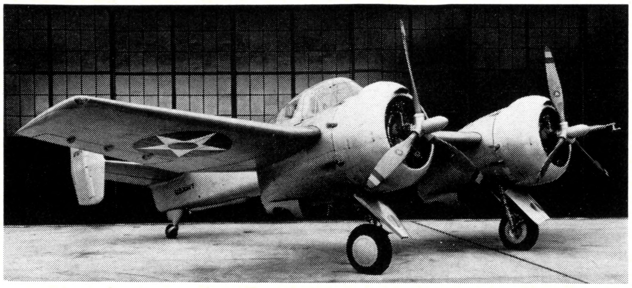


(Immediately above) The FM-1, illustrated in service with the Royal Navy as the Wildcat V, was essentially similar to the F4F-4 illustrated by the general arrangement drawing below.

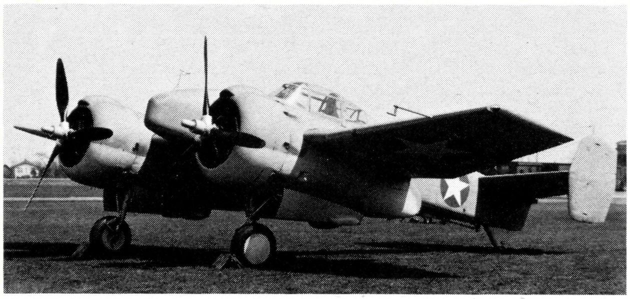




(Above and below) The XF5F-1 "Skyrocket" in the configuration in which it was originally flown.



(Below) The XF5F-1 in its definitive configuration, with extended nose, lengthened engine nacelles and arrester hook.



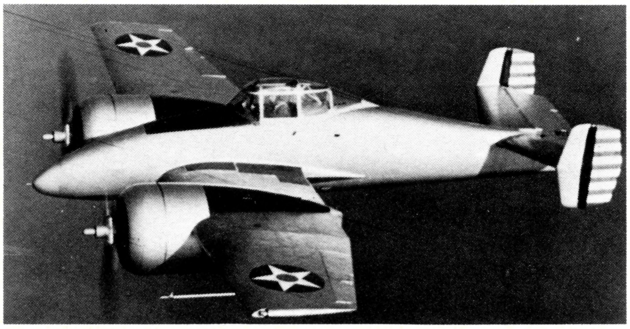
as the FM-1, the R-1830-86 Twin Wasp engine being retained but wing armament being reduced from six to four 0·5-in (12,7-mm) guns and ammunition capacity being raised (from 1,440 to 1,720 rounds). The first FM-1 was flown on 31 August 1942, a total of 1,151 subsequently being built of which 312 were assigned to Britain as Martlet (later Wildcat) Vs. The version of the Wildcat built in largest numbers by General Motors, however, was the FM-2, the first version of the fighter produced for the US Navy to standardise on the Cyclone engine. The FM-2 was the production version of the XF4F-8, two prototypes of which were built by Grumman with the first flying on 8 November 1942. The FM-2 retained the four 0·5-in (12,7-mm) gun armament, but had a 1,350 hp Wright R-1820-56 Cyclone and redesigned, taller vertical tail surfaces. A total of 4,777 FM-2 Wildcats was built of which 370 were assigned to Britain as Wildcat VIs. The following data relate to the standard FM-2. Max speed, 289 mph (465 km/h) at sea level, 319 mph (513 km/h) at 19,600 ft (5 980 m). Time to 10,000 ft (3 050 m), 4·5 min. Max range (clean), 780 mls (1 255 km). Empty weight, 5,542 lb (2 516 kg). Max loaded weight, 8,221 lb (3 732 kg). Dimensions: Span, 38 ft 0 in (11,59 m). Length, 28 ft 9 in (8,77 m). Height, 11 ft 5 in (3,48 m). Wing area, 260 sq ft (24,15 m²).

GRUMMAN (G-34) XF5F-1 USA

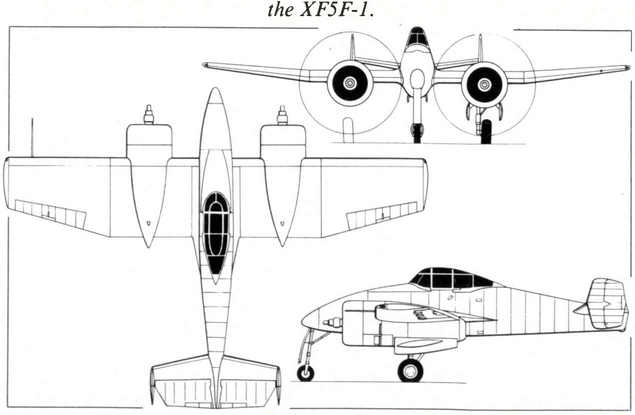
Ordered as a prototype on 30 June 1938 by the US Navy Bureau of Aeronautics, the XF5F-1 was of radical concept in that it was intended as a *twin*-engined shipboard fighter, and this at a time when the first *single*-engined shipboard fighter monoplanes were only just commencing flight test. Conceived as the G-34 Skyrocket, the XF5F-1 was flown on 1 April 1940, and, in its initial form, had a singular appearance resulting from an abbreviated forward fuselage, the wing leading edge extending ahead of the fighter's nose. Powered by two 1,200 hp Wright XR-1820-40/42 radials and having provision for two 23-mm Madsen cannon, the XF5F-1 underwent some redesign as a result of testing, the engine nacelles being lengthened, the fuselage nose being extended, etc. Flight testing of the XF5F-1 provided information utilised in the development of the more advanced XF7F-1 (G-51). Max speed, 383 mph (616 km/h) at sea level, 380 mph (611 km/h) at 16,500 ft (5 030 m). Max climb, 4,000 ft/min (20,32 m/sec). Range, 1,200 mls (1 930 km) at 210 mph (338 km/h). Empty weight, 8,107 lb (3 677 kg). Loaded weight, 10,138 lb (4 599 kg). Span, 42 ft 0 in (12,80 m). Length, 28 ft 8½ in (8,75 m). Height, 11 ft 4 in (3,45 m). Wing area, 303·5 sq ft (28,19 m²).

GRUMMAN (G-46) XP-50 USA

A land-based version of the shipboard XF5F-1 was offered to the US Army Air Corps as the G-46 while the prototype naval fighter was still under construction, and this was ordered as the XP-50 on 25 November 1939. The XP-50 was essentially similar to its shipboard counterpart, apart from having a lengthened nose to accommodate the nosewheel member of a tricycle undercarriage, and, powered by two turbo-supercharged Wright R-1820-67/69 engines, was intended to carry an armament of two 20-mm cannon and two 0·5-in (12,7-mm) machine guns. The XP-50 flew for the first time on 14 May 1941, but the aircraft was destroyed as a result of a turbo-supercharger explosion, further development being abandoned in favour of the more advanced XP-65 (G-51), which, in the event, was also to be discontinued. The following performance data is based on manufacturer's estimates. Max speed, 424 mph (682 km/h) at 25,000 ft (7 620 m). Range, 585 mls (941 km) at 317 mph (510 km/h) at 10,000 ft (3 050 m). Time to 20,000 ft (6 095 m), 5·0 min. Empty weight, 8,307 lb (3 768 kg). Max loaded weight, 13,060 lb (5 924 kg). Span, 42 ft 0 in (12,80 m). Length, 31 ft 11 in (9,73 m). Height, 12 ft 0 in (3,66 m). Wing area, 304 sq ft (28,24 m²).



Seen above during its sole flight and illustrated by the general arrangement drawing below, the XP-50 was a land-based derivative of the XF5F-1.



INTERNATIONAL

TRANSALL C 160S AND C 160ASF

WITH the Transall C 160 now re-established in production, initially to meet *Armée de l'Air* requirements for an additional 25 aircraft, Aérospatiale has projected several new variants of the basic twin-turboprop transport to broaden its market appeal. The programme, shared jointly between Aérospatiale in France and the MBB/VFW company in Germany, has been relaunched on the basis of a 75-aircraft production run; apart from the *Armée de l'Air* commitment the only contract concluded so far is for three C 160s ordered by the Indonesian government, for 1982 delivery.

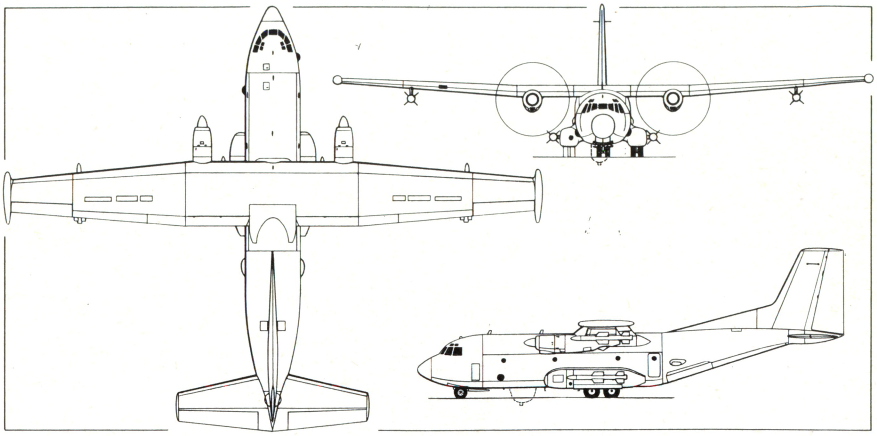
The new variants now on offer include two alternatives for maritime reconnaissance, identified as the unarmed C 160S and armed C 160ASF, the latter differing primarily in having provision to carry four ASMs, an all-round scan radar installation and additional electronic sensors. The C 160S uses the standard Transall airframe with few modifications but a suitable set of equipment to suit it for the rôles of coastal and over-water surveillance, vessel identification, search and rescue and fishery patrols. This equipment includes the standard communications, flight control and navigation system adopted for the Transall transport, with the nose-mounted ORB-37 weather radar replaced by a multi-mode radar such as the ORB-32 or Thomson-CSF Varan, with a 224-deg lateral sweep. The main display console for the radar is located at the navigator's station in the forward fuselage, with a small repeater for the pilot.

To supplement the radar surveillance, the C 160S is provided with two semi-spherical observation windows, one at floor level adjacent to an upholstered bench and the other for a seated observer. Identification facilities include two OMERA 35 cameras in lateral blisters on the rear fuselage, linked to the navigational computers to record precise details of date, time and position on each exposure. Up to 32 flares, in clusters of four, are carried in the port landing gear fairing, and are ejected with the help of Alkan cartridge squibs.

Rescue facilities include a container that can be used to drop a raft or various supplies by parachute; a complete SAR system that can be launched through the open rear doors, using a trolley running along the tracks of the aircraft's standard automatic mooring system, and a universal launcher through which various stores of up to 5 in (12,7 cm) diameter can be dropped without opening the doors.

In the projected C 160ASF, the ORB-32, Varan or similar radar is mounted in a retractable radome under the front fuselage to obtain 360 deg scan. Additional DF and detection sensors are carried in wing-tip fairings and air-to-surface missiles are carried on two underwing pylons and one on each undercarriage fairing. While the display unit for the radar will be located at the navigator's station, as in the C 160S, provision is also made for a control igloo to be fitted into the fuselage, tied down to the LTS A13 automatic mooring system and containing more completely-equipped surveillance avionics and operator's stations.

On its standard fuel capacity, the C 160S has a patrol endurance of 14 hrs at a distance of 500 naut mls (925 km) from base. In-flight refuelling is an option, using the system designed for installation in the new production series of the Transall following a series of trials last year with one of the original C 160Fs. Of the new production batch for the *Armée de l'Air*, 10 are to be fitted with hose and drogue units (HDUs) in the port landing gear fairing to serve as tankers and five others will have structural provision for the same equipment; the refuelling probe is mounted above and behind the flight deck.



A three-view drawing of the Transall C 160 ASF, one of the two projected maritime surveillance variants.

The following data refer to the new production Transall C 160 as a transport; the maritime surveillance versions will operate at the same gross weight and will therefore have generally similar performance.

Power Plant: Two Rolls-Royce Tyne 22 turboprops each rated at 6,100 ehp for take-off and driving Ratier Forest-built BAe Dynamics four-bladed constant-speed feathering and reversing propellers of 21 ft 4 in (6,50 m) diameter. Basic fuel capacity, 4,190 Imp gal (19 050 l); optional wing centre-section tanks for 1,980 Imp gal (9 000 l).

Performance: Max level speed, 277 kts (513 km/h) at 16,000 ft (4 875 m); initial rate of climb, 1,300 ft/min (6,6 m/sec); single-engined climb rate, 300 ft/min (1,51 m/sec); service ceiling, 28,000 ft (8 535 m); single-engined ceiling, 10,000 ft (3 050 m); range, 1,000 naut mls (1 852 km) with 35,275-lb (16 000-kg) payload and 30-min reserves; max ferry range, 4,780 naut mls (8 858 km).

Weights: Typical operating weight empty, 63,934 lb (29 000 kg); max payload, 35,274 lb (16 000 kg); max take-off weight, 112,435 lb (51 000 kg).

Dimensions: Span, 131 ft 3 in (40,0 m); length, 106 ft 3½ in (32,40 m); height, 38 ft 2¾ in (11,65 m); undercarriage track, 16 ft 9 in (5,10 m); wheelbase, 34 ft 4½ in (10,48 m).

Accommodation: Flight crew of three (two pilots and flight engineer) plus (in C 160S) two radar operators and two observers.

USA

CESSNA T182 TURBO SKYLANE

THE only addition to the Cessna single-engined line of general aviation aircraft for 1981 is the Turbo Skylane — as the name suggests, a turbo-supercharged version of the basic Model 182 Skylane. The 235 hp Lycoming engine already used to power the retractable-undercarriage Turbo Skylane RG is now offered in the standard fixed-gear Skylane to boost the performance and payload. At the same time, Cessna has announced a 150-lb (68-kg) increase in the gross weight of the basic Skylane model, to match the weight of the Turbo Skylane version. A number of small improvements also have been adopted as standard for both models, and a three-bladed propeller is an optional alternative for the two-blader on the Turbo Skylane.

The Turbo Skylane is offered by Cessna at a basic price of $62,250 (£25,900); with the standard Cessna "II" package of avionics and accessories the price increases to $70,200 (£29,150), and with the addition of Nav/Pac equipment, to $74,100 (£30,800). By comparison, the unsupercharged Skylane is priced at $51,500 (£21,450), $59,685 (£24,900) and $63,565 (£26,500) respectively.

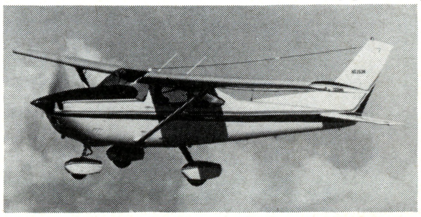
Power Plant: One 235 hp Avco Lycoming O-540-L3C5D flat-four piston engine driving a two-bladed constant speed propeller of 6 ft 10 in (2,08 m) diameter. Fuel capacity, 92 US gal (348 l).

Performance: Max speed, 168 kts (311 km/h) at 20,000 ft (6 100 m); cruising speed, 158 kts (293 km/h) at 20,000 ft (6 100 m) and 145 kts (269 km/h) at 10,000 ft (3 050 m) at 75 per cent power; initial rate of climb, 965 ft/min (4,9 m/sec); max certificated operating altitude, 20,000 ft (6 096 m); take-off distance to 50 ft (15,2 m), 1,475 ft (450 m); landing distance from 50 ft (15,2 m), 1,350 ft (411 m); range, 745 naut mls (1 380 km) at 20,000 ft (6 100 m) at 75 per cent power; max range, 920 naut mls (1 704 km) at 10,000 ft (3 050 m).

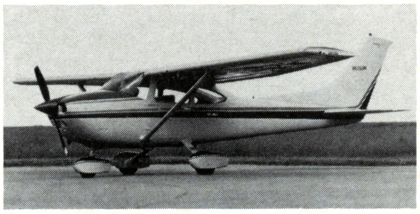
Weights: Standard empty weight ("II" package installed), 1,781 lb (808 kg); max useful load, 1,331 lb (604 kg); max take-off weight, 3,100 lb (1 406 kg); max landing weight, 2,950 lb (1 338 kg).

Dimensions: Span, 35 ft 10 in (10,92 m); length, 28 ft 5 in (8,66 m); height, 9 ft 3 in (2,82 m); undercarriage track, 9 ft 0 in (2,74 m); wing area, 174 sq ft (16,2 m²); dihedral, 1 deg 44 sec constant.

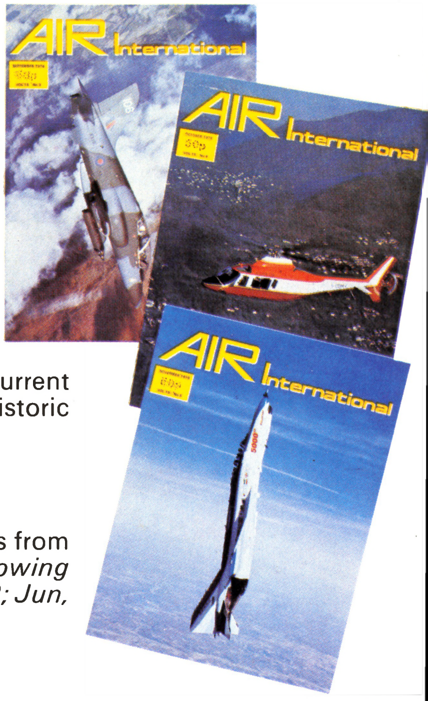
Accommodation: Four seats, including pilot.



Air and ground views of the T182 Turbo Skylane, one of the recent additions to the Cessna line.



AIR International



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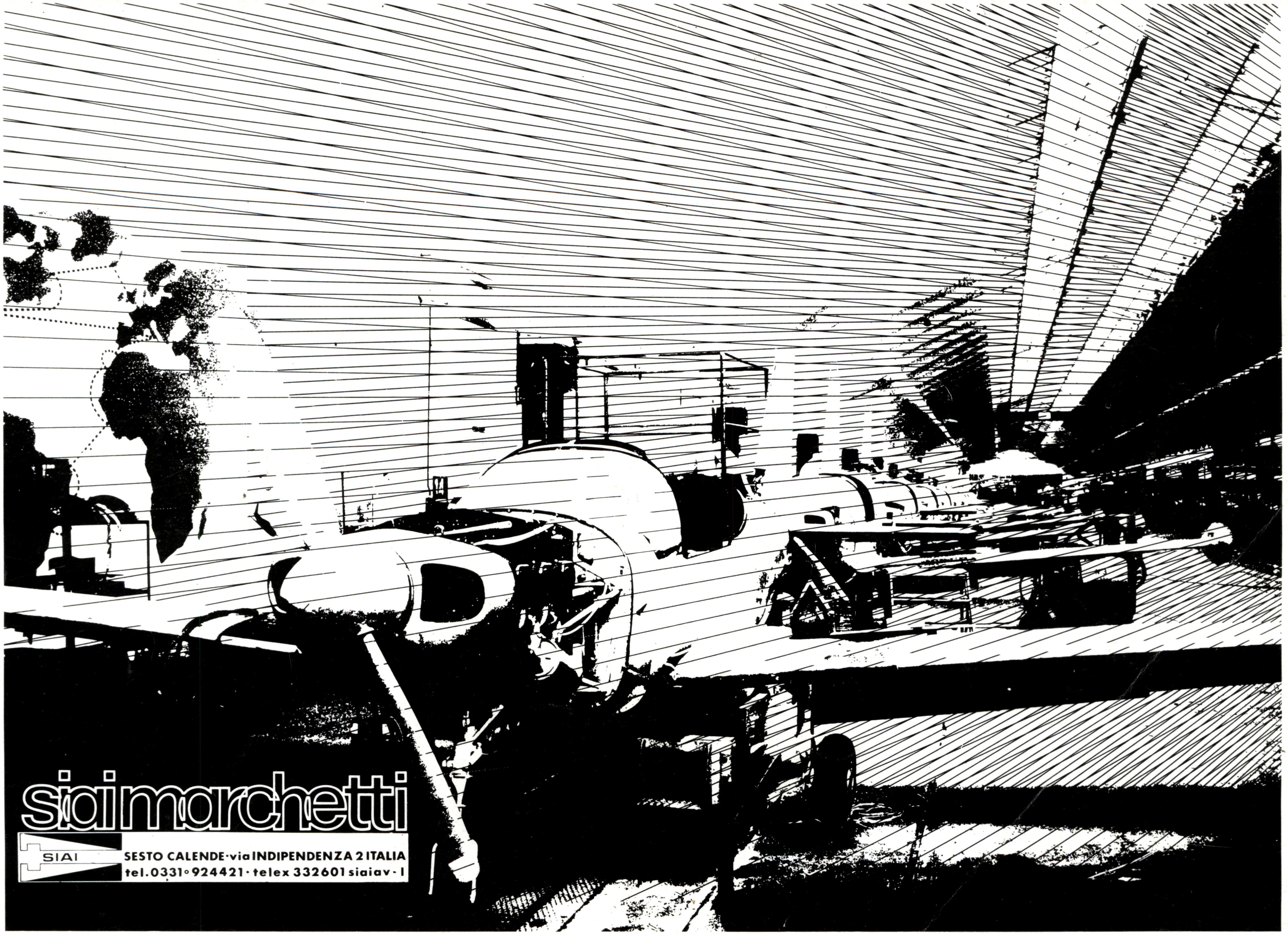

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